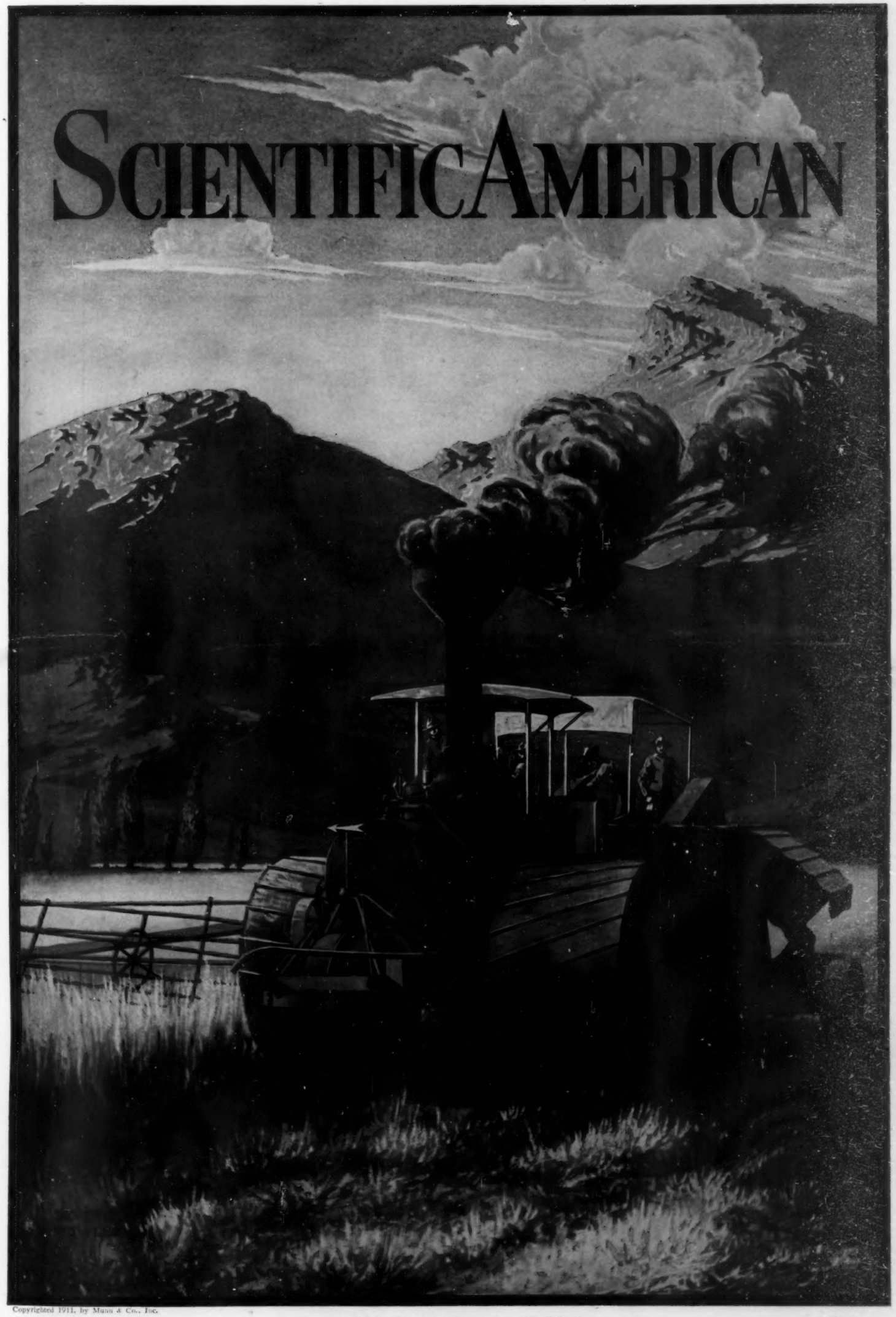
SCIENTIFIC AMERICAN



Copyrighted 1911, by Munn & Co., Inc.

Vol. CIV. No. 7
February 18, 1911

MUNN & CO., Inc., Publishers
New York, N. Y.

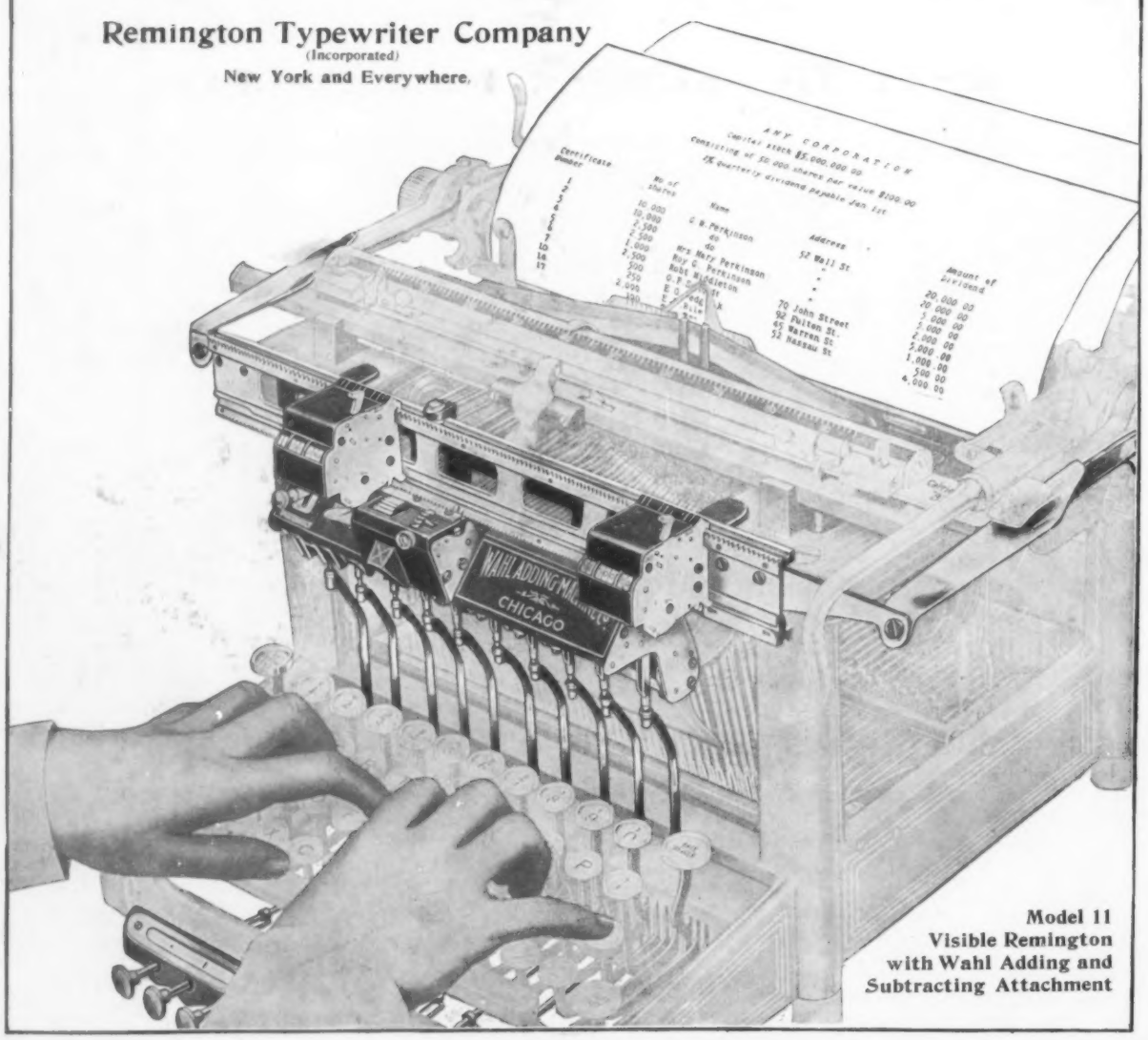
Price,
10 Cents

All Recent Typewriter Progress is Remington Progress

The *first* column selector
The *first* built-in decimal tabulator
The *first* key-set tabulator
The *first* adding and subtracting typewriter

REMINGTON

Remington Typewriter Company
(Incorporated)
New York and Everywhere.



Model 11
Visible Remington
with Wahl Adding and
Subtracting Attachment

CEMENT

The MARCH MAGAZINE NUMBER of the SCIENTIFIC AMERICAN ISSUE of MARCH 18th, 1911

¶ The *Scientific American* opened the new year with promises to its subscribers and friends, of larger issues and of mid-month numbers embellished with colored covers and composed not only of the regular material appearing in the *Scientific American*, but of material relating to some special topic as well.

¶ With this issue, we inaugurate the first of the promised monthly magazine numbers, in this instance a number partly devoted to those scientific aspects of modern agriculture which show that the farmer is reaching out from his ancient calling of merely tilling the soil in a haphazard way, into the higher spheres of chemistry, physics and bacteriology.

The March Magazine

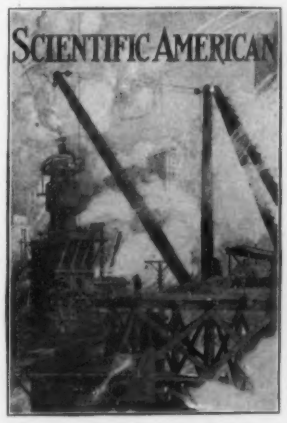
¶ Following this plan, the next mid-month number, which will bear the date of March 18, will embody the regular features of the *Scientific American*, and, in addition, a remarkable and highly instructive series of articles on the use of cement. We cannot but feel that in no popular magazine has there ever been gathered together a series of articles on the uses of cement which drive home so tellingly the wonderful versatility of a substance, at once one of the oldest and the newest of architectural materials.

¶ Every article is written by a man who has actually worked in the field which he is describing, and who is, therefore, able to express himself authoritatively on the results achieved.

WHAT THE NUMBER WILL CONTAIN

The Manufacture of Cement

¶ First of all, there will be an explanatory article, something in a pedagogic strain, so simply worded, however, that a reader who really wishes to learn cannot fail to understand the message written. That article will answer the question "What is Portland cement?" In addition, it will answer the questions "Why is it called Portland cement?" "How is it made?" Mr. E. D. Boyer, a leading cement expert, is the author of the article. He literally transports you into a cement factory, takes you by the hand and guides you through the plant, and shows, step by step, the processes through which raw rock must pass before you can buy it in the form of a barrel of cement.



Cement in Ancient and Modern Times

¶ Like many a new invention, Portland cement is as old as civilization. It remained for the modern engineer and architect to develop the substance to its highest pitch of perfection. Mr. Albert Moyer will contrast the ancient with the modern use of cement, and show the wonderful adaptability of the material.

The Mimicry of Cement

¶ When the ordinary cement block first came into being, its ugly, uninteresting gray surface damned it in the eyes of the artistic. Nowadays we know how to color cement, so that it can assume almost any shade desired, and so that it can duplicate the texture of different colored granites and other stones. This phase of the subject is ably treated by Mr. Fred Norris, a leading expert in such work.

The One-Piece House

¶ Much has been written of late in magazines and newspapers on the subject of the monolithic cement house. The story of the amazing achievement of casting a house simply by pumping into special forms liquid material which later becomes as hard as stone, has never been fully told. Mr. J. P. H. Perry, who has built house after house on this new plan, will explain the progress that has been made in this method of building. What is more, he will tell you how far the method is practicable in the light of our present knowledge of cement. There will also be descriptions of other systems of house building with portable forms.

The Problem of Waterproofing

¶ There are many who hesitate to employ Portland cement because someone told them it was impossible to make a cement house waterproof. It cannot be denied that a difficulty exists. Yet the principal and practically the chief problem to be solved is the construction of foundations which will prevent the seepage of moisture through concrete walls into cellars. Just what should be done to waterproof the foundation cellar walls is fully set forth by Mr. Ralph Davison, an expert in waterproofing materials. He gives detailed and practical examples to cover all the situations that may arise.

The Relation of Cost to Supply

¶ In addition to the contributions enumerated, there will be a statistical article which will graphically compare the increase in the use of cement and the corresponding decrease in the price of cement.

REGULAR SCIENTIFIC AMERICAN FEATURES

All these articles, and others which we hope to publish on the subject of cement, will appear as an addition to the regular Scientific American. There will, for instance, be the usual Aviation page, the abstracts from current periodicals, the Inventor's Department, and those articles which discuss the scientific achievements of the hour and which would naturally find a place in the Scientific American as soon as they are announced.

Munn & Co., Inc., Publishers, 361 Broadway, New York City

INTERNATIONAL AGRICULTURAL CORPORATION

Largest Miners *of* Potash Salts *in the* World

Miners and Shippers of

Florida Land Pebble Phosphate Rock

74–75% Bone Phosphate of Lime
68–70% Bone Phosphate of Lime
66–68% Bone Phosphate of Lime

and

Tennessee Phosphate Rock

72–78% Bone Phosphate of Lime, Brown Rock
60–65% Bone Phosphate of Lime, Blue Rock

Largest Producers *of* Acid Phosphate *in the* United States

Manufacturers of

All Grades of Commercial Fertilizers

Dealers in

Agricultural Chemicals *and* Fertilizer Materials

Factories at Advantageous Points

GENERAL OFFICES
165 BROADWAY, NEW YORK

SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CIV.] NUMBER 7 ★ NEW YORK, FEBRUARY 18, 1911 ★ [10 CENTS A COPY $3.00 A YEAR

PLOWING SIX FURROWS AT ONCE.—[See page 170.]

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, FEBRUARY 18, 1911

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary and Treasurer; all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter

Copyright 1911 by Munn & Co., Inc.

Subscription Rates

Subscription one year $5.00
Postage prepaid in United States and possessions, Mexico, Cuba, and Panama
Subscriptions for Foreign Countries, one year, postage prepaid, 4.50
Subscriptions for Canada, one year, postage prepaid, ... 5.75

The Scientific American Publications

Scientific American (established 1845) . . . . . per year, $5.00
Scientific American Supplement (established 1876) . " " 5.00
American Homes and Gardens . . . . . " " 3.00
The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check.

Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The New Stars

THE new stars which have been recently discovered in Sagittarius, Ara, and Lacerta have once more attracted attention to a class of bodies which for ages have puzzled astronomers and which, of late years, have been intimately connected with nebular and other cosmogonical hypotheses. In astronomical annals the blazing forth of a new star in sudden magnificence has been linked with the name of some astronomer who later became famous.

Thus, the appearance in 134 B. C. of a new star in the Scorpion suggested to Hipparchus the construction of a new catalogue of stars, which, with slight alterations, remained the standard for nearly sixteen centuries and which led to the notable discovery that some of the so-called fixed stars are in motion.

The appearance of a remarkably brilliant star in the constellation Cassiopeia in November, 1572, served the purpose of reviving Tycho's waning interest in astronomy, prompted him to apply a variety of methods to the new body for the purpose of ascertaining whether it had any perceptible parallax, and led him to conclude that the mysterious orb must belong to the region of fixed stars—to us a rather insignificant deduction, but at that time of vast importance in view of the generally maintained Aristotlean doctrine that the heavens generally, and the regions of the fixed stars in particular, were incorruptible and unchangeable, and that new stars, like comets, must belong to the higher regions of our own atmosphere. The work which he wrote on that body later induced Kepler to remark: "If that star did nothing else, at least it announced and produced a great astronomer."

Tycho's star must have been a body of astonishing splendor. He tells us that the star was seen by some at noonday, that it declined after a few weeks, and disappeared altogether in sixteen months. So exact are the measurements that he made that the telescope can be directed to the precise spot where he saw his matchless orb; but no such star as he described is there to be seen. It has been suspected by some astronomers that a tenth magnitude star, situated not far from the position indicated by Tycho, may be his lost nova.

The fitful gleaming of a new star was the occasion of Galilei's first contribution to astronomical discovery; for the star that flared up in 1604 in the constellation Serpentarius was shown by him to be at any rate more distant than the planets, a result confirming Tycho's conclusions that changes take place in the celestial regions even beyond the planets and are by no means confined, as was commonly supposed, to the earth and its immediate surroundings. In his great astronomical treatise "Dialogue on the Two Chief Systems of the World, the Ptolemaic and Coppernican," his character Salviati bases some of his most potent arguments for the acceptance of the Coppernican theory on new stars.

The same body moved the great Kepler, who stands perhaps second to Newton in the perseverance and ingenuity which he displayed in solving the riddles of the universe, to write two pamphlets on its vagaries.

In later times, novæ engaged the attention of Herschel in his attempts to estimate the relative distances of stars from the earth, their arrangement in space, the variability of their light, and their magnitude.

The new star that blazed wonderfully in the constellation Perseus on February 22, 1901, and was first seen by the Scotch astronomer Anderson, is the only body at all comparable in splendor with that of Tycho. In rosy tint was curiously like that of the recently discovered Nova barertæ. The new star in Perseus grew brighter and brighter, faded, and then regained something of its former brilliancy. Thus it fluctuated in brilliance with noticeable regularity. So inexpressibly distant is the constellation Perseus that the light of its stars, flashed through space at a speed of 186,000 miles a second, reaches this earth only after a lapse of 120 years. What Anderson discovered, therefore, was a light that suddenly flared up in 1781, while the American colonies were still fighting for independence. And so the new stars which have been recently discovered belong, not to our own day and generation, but to a time when there were no railroads, telegraphs, telephones or steamboats.

What are these mysterious bodies? It would be rash indeed to dogmatize. The spectroscope has revealed the secrets of their composition, and has linked them in chemical kinship with nebulæ. Indeed, the opinion is fast gaining ground that there is some intimate physical relation between novæ and nebulæ. Arrhenius, in his remarkable cosmogony, "Das Werden der Welten," has done much to further that view. What Anderson saw in Perseus, Tycho in Cassiopeia, and astronomers of our own day in Sagittarius and Lacerta, are to him superb cataclysms. He draws a vivid picture of two giant suns, chilled to black cinders, but still imprisoning within their frozen shells a fierce heat and compounds of terrific explosive energy, crashing together in a celestial head-on collision. When that catastrophe occurred, each dead sun was rushing through space at the rate of 400 miles a second—faster by seven hundred times than a projectile fired from a modern 12-inch gun. Two enormous bodies, traveling at such frightful speed, cannot be suddenly arrested without in some way disposing of their energy. Part of this energy is converted into a heat so intense that the fragments of the two shattered suns glow with a dazzling light. The remainder of the energy, according to Arrhenius, is spent in twisting the fragments around a common center at a speed of hundreds of miles a second, so that a huge spiral nebula is created, examples of which we find in Canes Venatici, Ursa Major, and the Triangle.

In that spiral nebula, Arrhenius sees the birth of a new solar system, or at least a world—not a rock-bound, sea-swept world such as ours, but a glowing chaotic mass. Gases and fine dust compose the spiral streams; and the dust, gathered in great revolving clouds, is periodically interposed between the earth and the star, thus causing those more or less regular obscurations which are characteristic of many new stars. Continuing his mechanical arguments, Arrhenius points out that the effect of this revolution on the mass of gas and dust is to produce a flat disk, intensely hot and dense at the center, extremely attenuated and cold at the remote outer edge. After the lapse of ages, he sees the spiral formation gradually obliterated by the action of gravitation and of other forces. He points to nebulæ for evidence of these mysterious processes, and regards them as the products of dust and gases thrown out by colliding dead sums. Out of these nebulæ planetary systems will be evolved by the age-long process of steady contraction and by the clustering of matter through attraction into globes, which will eventually congeal into worlds.

No astronomer would be rash enough to accept this theory unhesitatingly. Astronomy is still in its infancy. Century after century must elapse before we can detect even the slightest change which would serve to confirm any such doctrine of stellar evolution. And century after century must elapse before other observations can be made and compared with the original observations and with observations made in our own and historic times to justify one in assuming that new stars and nebulæ are indeed the stuff of which solar systems are made. Speculations such as these are scientifically useless to a large extent, but they show that the modern physicist can frame scientific epics of true Homeric grandeur.

An Example in Turbine-Steamer Construction

THE question of efficiency and adaptability of the steam turbine, as compared with reciprocating engines, for marine use, has in the past received much attention. The problem of the turbine steamship has now passed far beyond the experimental stage, a considerable number of our largest steamships being to-day equipped with powerful turbine engines. But this branch of marine engineering is still very young, and every contribution to the knowledge of the theory and practice of the turbine steamer must be welcomed by all interested. In this connection a paper recently presented to the Society of Naval Architects and Marine Engineers by C. H. Crane deserves our attention. It relates to the rebuilding of the steam yacht "Vanadis," a boat which was originally equipped with Parsons turbines with high-pressure center and two low-pressures driving the wing screws. The boat was delivered by the builders with a guaranteed consumption of 26 tons of coal per 24 hours at cruising speed of 13 knots. The owner, however, found that the engines were consuming coal much in excess of the guaranteed amount. So serious was the discrepancy between the guaranteed and the actual figures, that the bunker capacity was quite inadequate to hold the amount of coal required for a run of normal length. An exhaustive test was therefore made, from which it was seen that the actual coal consumption was 33 tons, i. e., 27 per cent. in excess of the guarantee. The problem then arose as to what could be done to remedy the existing defects. Three ways seemed to be open out of the difficulty. The vessel might be lengthened, or the turbines might be entirely replaced by twin reciprocating engines. Lastly, the high-pressure turbine might be replaced by a reciprocating engine, exhausting into the two low-pressure wheels. The last was the expedient actually employed. The operation proved an entire success, the coal consumption falling to 22.5 tons, i. e., considerably below the figure of the original guarantee, at a speed of 13.3 knots. Recomputed on a basis of 13 knots, this corresponds to a consumption of 22.7 tons.

We have here an interesting example of the use of the low-pressure turbine for the economical utilization of that end portion of the steam expansion which cannot, in the reciprocating engine, be profitably utilized. The steam turbine is particularly adapted for work under these conditions, and by the happy combination of the two types of engine, the builders finally found themselves in a position, not only to fulfill their guarantee, but to present their client with a small extension of the cruising radius.

Seeing Things at Night

MANY people have wondered why, in a dim light, familiar objects are apt to assume fantastic and frequently alarming appearances. The scientists say that the explanation is to be found in the special conditions of night vision. The pupils are widely dilated and, as in the photographic lens with a large diaphragm, the apparatus of accommodation can focus only for the plane. As the faculty of estimating distances is in great measure lost in the obscurity, we cannot focus with precision, and a blurred uncertain outline is thrown upon the retina.

Then, too, colors viewed in a fading light lose their distinguishing hue in a fixed sequence until a point is reached at which everything becomes of one uniform gray tint.

The images that are transmitted to the visual centers are, therefore, profoundly modified in color and outline; and as they enter the eye through the widely dilated pupil at an altogether unusual angle, the movement of locomotion gives them a peculiar mobility.

Now, one relies on experience for the interpretation of sensorial impressions; and when these present themselves suddenly in an unusual form, they create a feeling of insecurity that finds expression in mental perturbation and more or less violent motor impulsion. In fact, the subject finds himself in the position of a horse that sees a rapidly approaching automobile for the first time, and does not know what "to make of it."

Imagination aiding, these blurred, mobile, and uncertain images are susceptible of the most phantasmagoric interpretations, and in persons who are not accustomed to control sensorial impressions by the exercise of the intelligence, the impressions are accepted as realities, and acted upon accordingly.

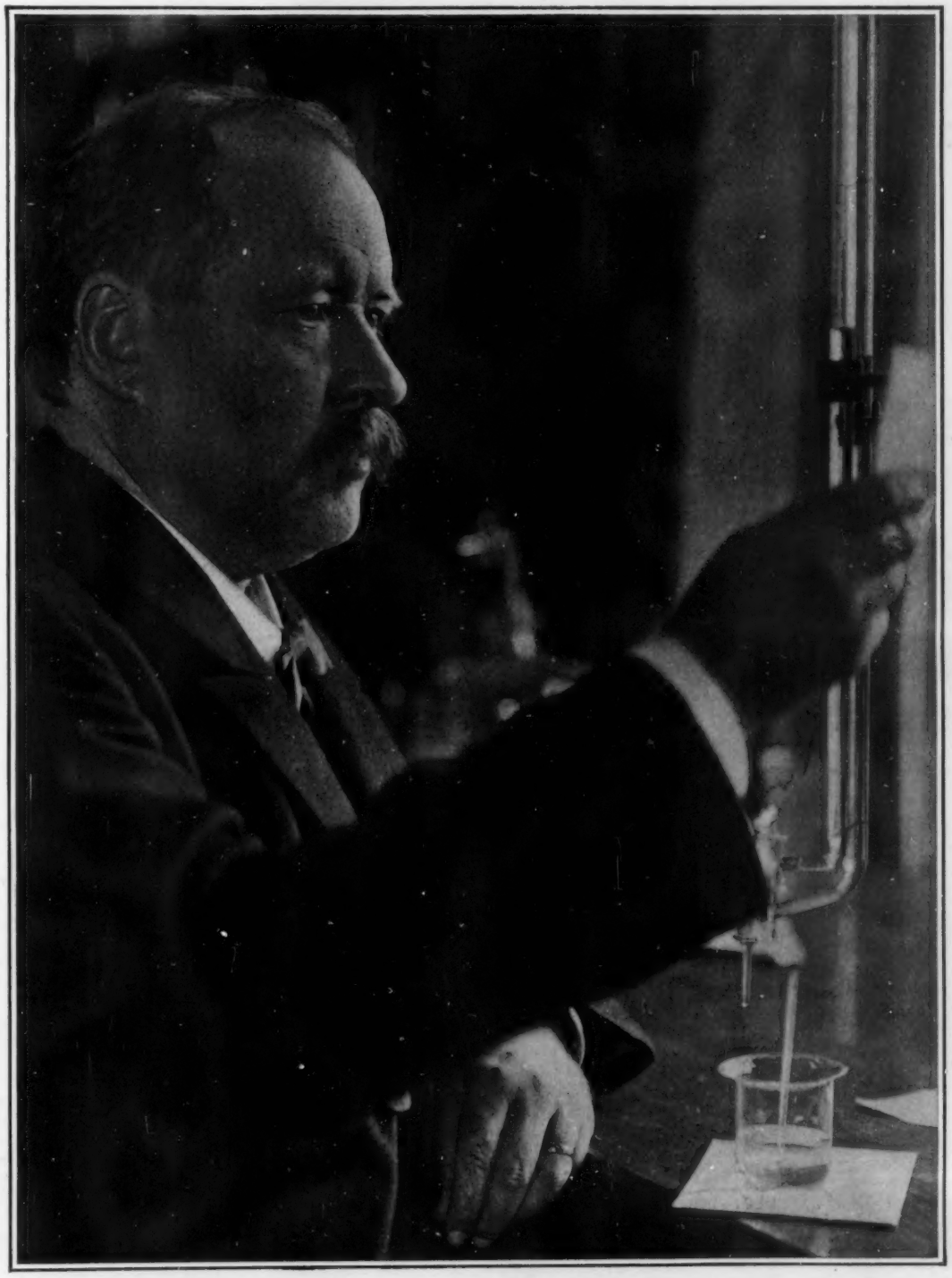
Men who are accustomed to night work in the fields make allowance for phenomena of this class, and correct the visual deficiency by the aid of other senses, such as hearing, which are not dependent on light.

Svante August Arrhenius

The Founder of the Theory of Electrolytic Dissociation

By Professor Wilhelm Ostwald

SVANTE AUGUST ARRHENIUS was born February 19th, 1859, near Upsala. His ancestors were farmers, and the name Arrhenius is a Latinized derivative of *arena*, meaning a river bank, the name of the family estate in the south of Sweden. His father was superintendent of grounds of the University of Upsala. At school Svante exhibited remarkable precocity and distinguished himself particularly in mathematics, physics and biology. He entered the University of Upsala in 1876, but in 1881 went to Prof. Edlund in Stockholm. He attained the degree of doctor of physics in 1884. His graduation thesis, "A Study of the Conductivity of Electrolytes," published in the same year, made a profound impression upon me.



Svante Arrhenius

I have devoted part of my life to the study of the chemical relation between acids and bases, and when that paper appeared, I had obtained for the specific affinities of various acids values closely agreeing with the results which Arrhenius had reached by a very different road. The method by which Arrhenius had attacked and partly solved the problem was far more comprehensive and fertile than my own. I was then connected with the polytechnical school of Riga, Russia, and there I repeated and extended the experiments by which Arrhenius had proved the approximate proportionality of the chemical affinities of acids and bases to their electrolytical conductivities, and published the results. Then I went to Upsala to support Arrhenius, whose views were regarded as heterodox, in obtaining a position in the university. A year later we worked together for several months at Riga.

In 1887 Arrhenius published his theory of electrolytic dissociation, probably the most important and prolific of his many achievements, which explained the observed anomalies in the freeing point of electrolytes and interpreted as a dissociation factor the irrational coefficient ($\sqrt{-1}$) in Van't Hoff's then new and much discussed theory of osmotic pressure. The new theory of electrolysis rapidly developed, explaining many well known but little understood phenomena of chemical equilibrium, analytical reactions, the concentration of electrolytes, the galvanic battery, the solubility of gases, etc.

This rapid success spared Arrhenius the waste of energy in polemics which the iconoclast usually suffers, and also assured him means of support and of further scientific activity. In 1891 he was called to the University of Giessen, but he preferred to accept a position in the new University of Stockholm, where his subsequent promotion to a professorship was due mainly to the influence of foreign scientists. In 1897, however, his colleagues chose him as their rector, or president, and he was twice re-elected to this position, which he finally declined in the interest of his scientific work. In 1905 he became director of the Nobel Physical Institute.

The theory of electrolytic dissociation soon gained so many enthusiastic young advocates that it continued to develop without direct aid from the founder, except where such aid was required to refute criticism and enlighten skeptics. In 1890 Arrhenius, Van't Hoff and I were invited to discuss the theory of solution with a committee of the British Association, the members of which were at least partially converted to the new views by their foreign guests, aided by William Ramsay. The new theory made rapid progress against strong opposition in Great Britain. French chemists refused to discuss or consider the theory at that time and they are still far behind their German and British colleagues in this line of research.

Arrhenius published a great many papers in the ten years that followed the announcement of the dissociation theory. In the succeeding decade his duties as rector of the new university, to which he devoted himself with great diligence and success, diminished his scientific output, but two new and very important phases of his activity belong to this period.

In connection with his early studies of the conductivity of solutions he had investigated electric conduction in silver chloride in light and in darkness, in phosphorescent and illuminated air, and in Bunsen flames in which various salts were vaporized. In 1888 he studied the influence of the sun's rays on the electrical state of the atmosphere. In 1895-8, in collaboration with Ekholm, he published researches on the moon's influence on auroras, thunderstorms and terrestrial electricity, the 26-day period of thunderstorms and auroras, and the effect produced on the earth's temperature by the carbon dioxide of the atmosphere. In 1898, also, appeared his remarkable paper on the effect of cosmical influences upon physiological conditions, which has apparently been overlooked by recent students of periodic vital phenomena.

In 1905 he astonished the scientific world with his two-volume Text Book of Cosmical Physics, containing many bold and original ideas in regard to the constitution and origin of the heavenly bodies. Still more recently appeared "Worlds in the Making," which exhibits in a striking manner the author's characteristic traits, independence and startling boldness of conception, the ability to regard apparently disconnected facts from a common viewpoint, and a masterly simplicity and comprehensiveness of result and statement.

The most striking novelty in the cosmogony of Arrhenius is the introduction of the pressure of radiation, which appears to be a very active factor, not only in the formation of comets' tails, but also in many more important cosmical processes.

Arrhenius has recently taken up the study of serum-therapy and has explained Ehrlich's important discoveries by a theory of unsaturated compounds, analogous to that which exists between weak acids and bases.—Adapted from an article published in "Die Forderung des Tages." Leipzig, 1910. Akademische Verlagsgesellschaft, m. b. H.

The Necessity of Longer Piers for the Port of New York

Advantages of Extending Pierhead Lines Stated and Objections Answered

By Calvin Tomkins, Commissioner of Docks, City of New York

*COMMISSIONER TOMKINS has recently made an exhaustive study of the problem of handling the rapidly growing water-borne freight and passenger traffic at New York; and his report contains a masterly plan, relieving the present congestion and taking care of the inevitable growth of the future. The Commissioner believes that, if the subject of extending the piers farther into the Hudson River be considered on the broadest grounds, it will be found that the interests of the nation, the State, the city and the steamship companies would alike be furthered by such extension.—*EDITOR.]

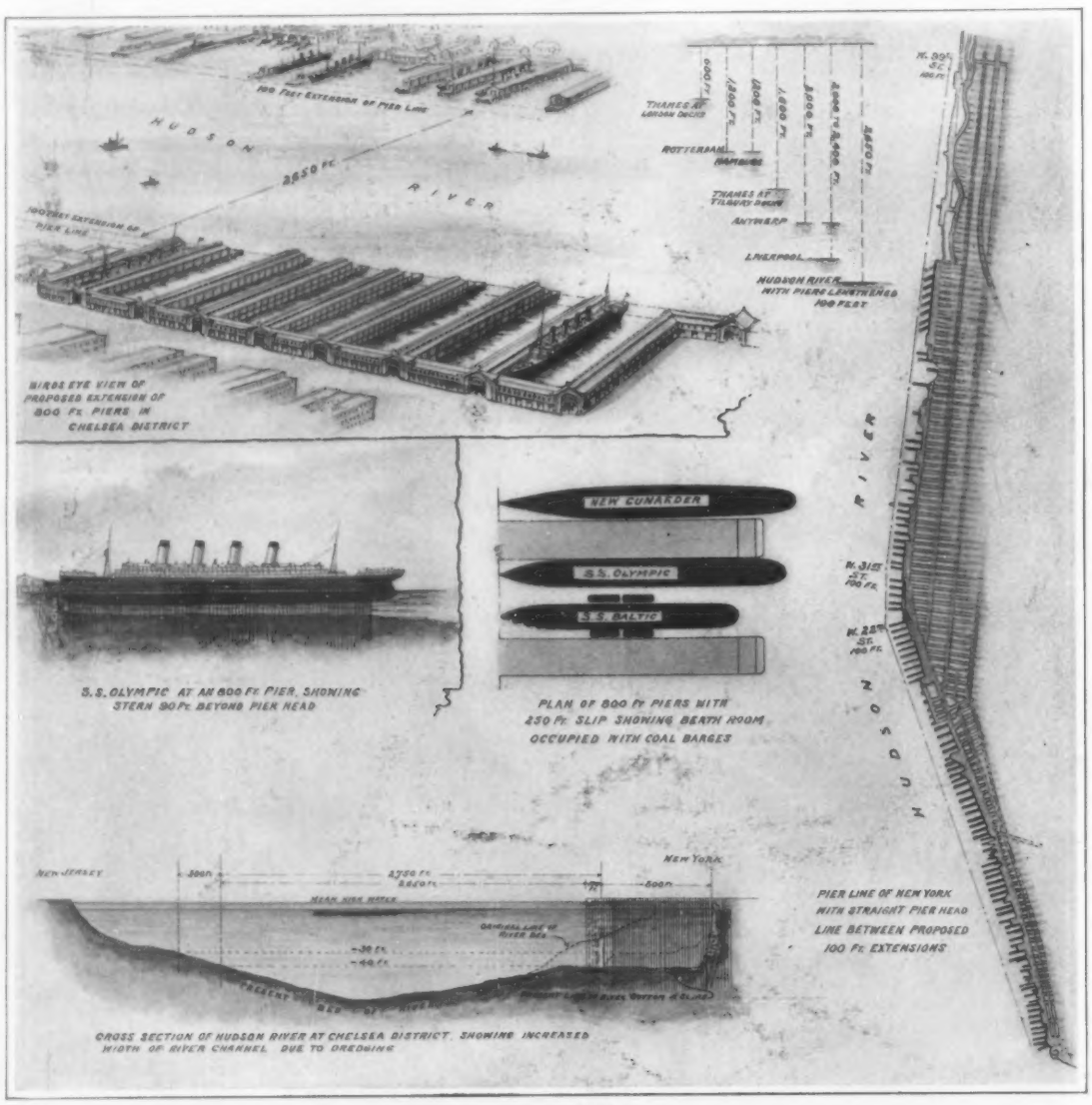
The application of the International Mercantile Marine, the Compagnie Generale Transatlantique, and the Cunard Steamship companies affords an opportunity for discussing the rearrangement of the pierhead lines on both sides of the Hudson River above the bay within the port of New York.

The interest of the city in this matter is identical with that of the general government and of the entire port, including both the New York and New Jersey sections; and it is important that New Jersey interests shall receive the same exhaustive and considerate attention as those of New York.

The trade and commerce of the city will for the time being be seriously affected, should it be found inexpedient to lengthen these piers. The city does not wish, however, to prejudice the future interests of the port of New York by any change made to meet merely temporary conditions, however exigient.

The two States New Jersey and New York, together with the Federal government, are jointly charged with the responsibility of fitting the physical plan of this, the greatest seaport of the world, to the expanding needs of its commerce. The city enters into this discussion unprejudiced and without bias of special interest, desiring only that the conclusion reached shall be the best and most comprehensive decision now attainable.

It is plain that the interests of the port will best be served by permitting ships to dock where they find it most convenient to receive and discharge passengers and cargo. New York is the great port for partial cargoes. Express freight and passenger steamers of the first class maintain liner service from here to the principal European ports; and second class passenger and bulk freight liner service is maintained to the other large ports of the world. Railroads and coastwise steamship lines converge at New York for the purpose of connecting with the liners centering here. The high-class and package freight business seeks terminals at Manhattan, since this class of freight is, for the most part, destined for Manhattan, and if landed at South Brooklyn it will necessitate transfer by lighter or truck to this borough. Passengers and their luggage can also be cared for more expeditiously, conveniently and economically here than elsewhere. The same reasons which impelled the Pennsylvania Railroad Company to establish its terminal here compel the great steamship companies to seek Manhattan dockage, since it is most convenient to hotels, railroad lines, amusements and wholesale and retail business. The passenger business has developed to unprecedented proportions within the last ten years, and most of the passengers who land at Manhattan spend some time and money in the city. In the aggregate this business is of the greatest advantage to the community and to the country at large. The fact that it is more convenient and economical to utilize deeper and longer vessels than formerly should not be permitted to count against the city's interests; and if this class of ships cannot dock at Manhattan as heretofore, the resultant injury to the city's trade will be serious indeed. This is the fundamental reason for desiring such reasonable pier extensions as can be made without prejudice to the permanent interests of the port.


HUDSON RIVER
2850 Ft.
100 FEET EXTENSION OF PIER LINE
BIRDS EYE VIEW OF PROPOSED EXTENSION OF 800 Ft. PIERS IN CHELSEA DISTRICT
THAMES AT LONDON DOCKS
ROTTERDAM
THAMES AT TILBURY DOCKS
ANTWERP
LIVERPOOL
HUDSON RIVER WITH PIERS LENGTHENED 100 FEET
NEW CUNARDER
S.S. OLYMPIC
S.S. BALTIC
S.S. OLYMPIC AT AN 800 Ft. PIER, SHOWING STERN 90 Ft. BEYOND PIER HEAD
PLAN OF 800 Ft. PIERS WITH 250 Ft. SLIP SHOWING BERTH ROOM OCCUPIED WITH COAL BARGES
NEW JERSEY
NEW YORK
MEAN HIGH WATER
-30 Ft.
-40 Ft.
CROSS SECTION OF HUDSON RIVER AT CHELSEA DISTRICT, SHOWING INCREASED WIDTH OF RIVER CHANNEL DUE TO DREDGING
PIER LINE OF NEW YORK WITH STRAIGHT PIER HEAD LINE BETWEEN PROPOSED 100 Ft. EXTENSIONS

THE PROPOSED EXTENSION OF THE PIER-LINE IN THE PORT OF NEW YORK

It is important that the pierhead lines be so established that the vessels of the future may be docked with the least possible inconvenience and expense, and that the present structures may be used to the greatest advantage. The city desires to meet the requirements of the future, but it is not willing to do so at the expense of the present.

PROPOSED EXTENSION.

If practicable, the city desires that the pierhead line may be extended 100 feet outshore from the present ends of the Chelsea piers and continued southward to the Battery, becoming coincident with the present pier line at Pier 1, and northward in a straight line to a point 100 feet outshore from Pier 71 at the foot of West 31st Street; thence parallel with the present pierhead line 100 feet outshore to a point approximately opposite West 99th Street. This extended line is shown on the map which I submit herewith. It is not necessary, however, that the line should at present be extended north of 81st Street. The city can coincidently arrange for additional pier lengths in the new district between West 34th and West 42d streets and between West 44th and West 50th streets by excavating 75 or 100 feet within the established bulkhead line of 1871. This is not shown in the map as reproduced on our illustration. Such an extension would provide numerous piers 900 feet in length above the Chelsea district.

The narrow part of the river is opposite the Chelsea piers, but above and below the river is wider. The extension below the Chelsea district would straighten the pierhead line and permit of pier lengths up to 1,100 feet. Should greater length be needed, it can be obtained by laying ships alongside of quays above 72d Street, or by providing diagonal piers similar to those of the New York Central Railroad Company in the West 60th Street section. Such piers, however, cannot at present be obtained in the lower districts without great inconvenience and expense, incident to the rearrangement and destruction of present structures which are now intensively used.

OBJECTIONS.

Three objections may be cited to such an extension of the pierhead lines:

1. That it will interfere with the currents and with the tidal prism.
2. That it must be considered in connection with a comprehensive adjustment of the pierhead line in New Jersey.
3. That it will unduly narrow the fairway.

In answer to the first objection I submit herewith a profile of the river between the New Jersey and the New York shores, showing that by excavation in the Chelsea district the city added 21 per cent to the cross section of the river. Further excavation inshore, above 23d Street, which it will be advisable to make subsequently, will add still more. These facts, I think, dispose of the contention that the tidal movements have been or will be adversely affected.

In answer to the second objection, I would state

(Continued on page 184.)

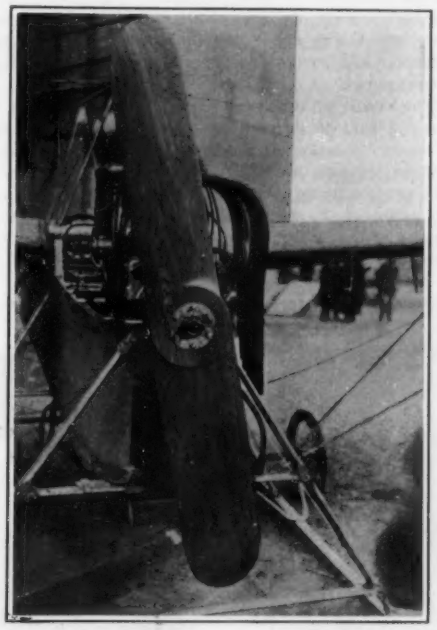
Some Recent French Monoplanes

Details of Several New Machines

THE accompanying photographs of some of the latest French monoplanes are instructive as showing the trend of design and construction in France. The most notable of the machines illustrated, the Robert Esnault Pelterie (R. E. P.) monoplane, is well known to our readers, not perhaps in the late form herewith shown, but in its general design, which appears to have been changed only in details. The Pelterie monoplane ranks with the Antoinette and the Blériot as one of the most carefully-built and best-designed of French machines. Pelterie was one of the band of Frenchmen who, early in the development of the art of flying, perceived the inherent possibilities of the monoplane. In arduous experimental flying and the multiplied risks incurred, Pelterie was a good second to that other monoplane exponent, Louis Blériot himself. The details shown in our photograph of the landing devices, carried just below the bow of the boat-like body of the R. E. P., reveal some good designing. There is a central skid, broad and strong, with its rear end hinged rigidly to the lowest tubular member of the aeroplane body, and the forward end carried by a hollow, telescopic strut. Each of the wheels is mounted on an independent axle, which appears to be hinged at the center of the skid, with a pair of diagonal struts extending from the outer ends of the axles to a connection (probably telescopic) with the bow. This arrangement should give considerable flexibility when a landing is made on rough ground. It will be noticed that the guy and warping wires are connected to their attachments at the bow by turnbuckles. Pelterie is too good a designer, probably, to commit the common error of using light turnbuckles, and he has no doubt given those used a good margin of strength. In an aeroplane, as in a yacht, turnbuckles should be made the subject of very careful selection. Too often they are weaker than the wires or steel bands to which they are attached. Care should be taken to see that the section of metal at the root of the threads is fully equal to the section of the metal in the connecting rods or wires.

This latest Pelterie model shows how greatly steel tubular construction is growing in favor among the French builders. The body frame is of steel tubing, as are also the frames of the tail and the horizontal and vertical rudders. These latter, as will be seen from our illustration, offer a good example of careful and neat design and workmanship. The tail consists of two triangular, horizontal surfaces at the rear to which are hinged the two sections of the elevating rudder. The vertical rudder also is in two parts, carried one above and one below the tail, and upon a common vertical axis. A broad skid of bent wood is mounted immediately below the vertical rudder and at the extreme end of the tail.

The new R. E. P. monoplanes have been considerably simplified and improved, and they have shown themselves to be very speedy machines. They are provided with a 7-cylinder air-cooled motor of 50 to 60 horse-power. The cylinders of this motor are in two planes, and are spread out like a fan. The engine is constructed along the same lines as heretofore, but it has been enlarged and improved.



A new propeller on a monoplane.

This propeller recalls the "stick of wood" with which Curtiss won the first Gordon Bennett race.

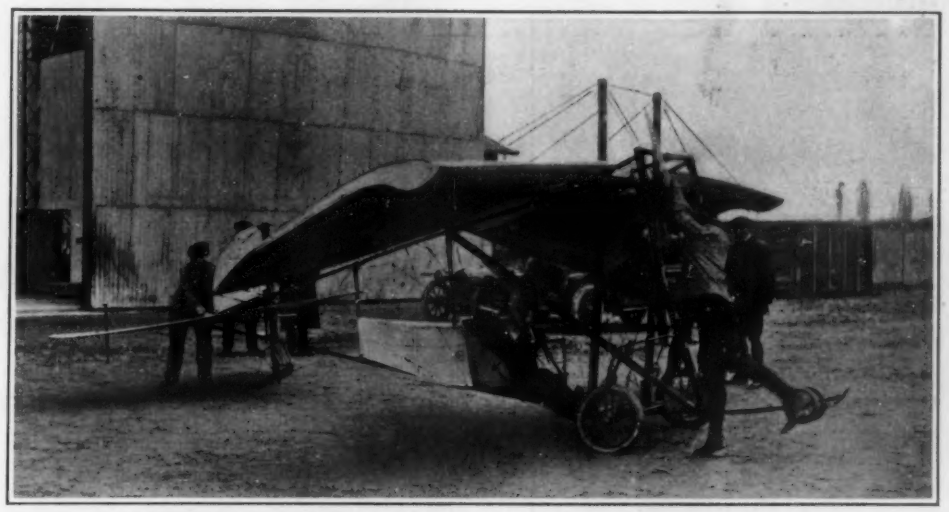
On the last day of the old year, an aviator named Pierre Marie, in competition for the Michelin Trophy, remained aloft six hours and twenty-nine minutes in his R. E. P. monoplane, covering three hundred and forty-one miles in a continuous flight. Had his fuel not given out, there is a strong probability that he would have won the Michelin prize. He broke all speed records beyond one hundred and fifty miles, his average speed for the total distance being at the high rate of fifty-three miles an hour. The above performances show that the new Pelterie monoplane is one of the fastest and best of the new French single-surface machines.

Another case of steel tubular construction is seen in the Nieuport monoplane, the tail and double rudders of which, together with one of the wings, are shown in one of our illustrations. The rudder is of the compound type with two vertical and one single horizontal surface, the whole rudder having universal movement controlled by wire leads. This is the machine in which the ill-fated Lieut. Caumont la Force fell to his death on December 30th last.

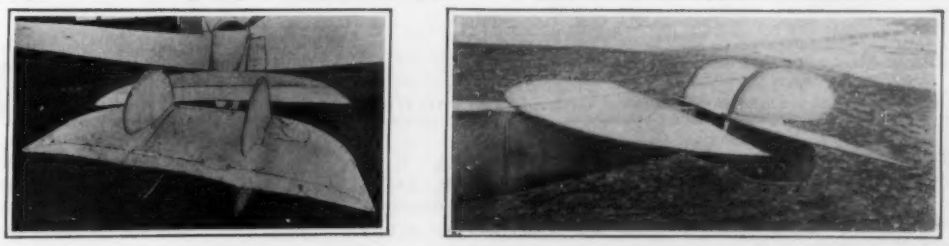
The Kaufmann machine is built, as will be seen from our illustration, from the general design of the Santos-Dumont "Demoiselle" monoplane. There are the same short and deep wings, and the same low center of gravity, the operator being seated but a few inches above the ground—a position of extreme peril in case of a fall or too rapid landing. The safeguards against a smashup in landing, however, seem to be pretty well worked out, the greater part of the load being taken on a pair of wheels carried in a tubular spring-controlled framework, while forward there is a projecting shoe carrying a pair of small landing wheels, and aft, under the tail, is a privoted skid controlled by heavy rubber bands.

An unusual feature, the reason for which is not apparent, is the great depth of the leading edge of the planes, there being nothing, as far as we know, in the dynamics of flight to warrant putting on the under side of the plane the big heavy bulge noticeable in the photographs.

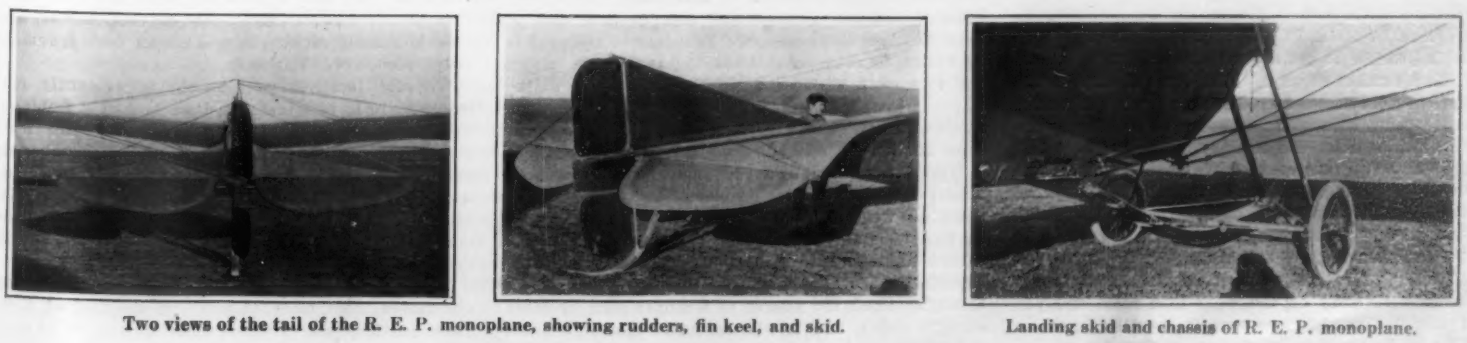
The unusual design of propeller which is shown on a monoplane, is said to have given good results in experimental flights. It will be seen that the projected width of the blades is uniform over their entire length. The theory of this propeller is that by engaging the air over a surface of uniform width, higher efficiency is obtained. It is claimed by the designer of this propeller—M. Raymond Petit—that a screw of this type 6½ feet in diameter gives more thrust than one of the more conventional type of 7¼ feet diameter. The propeller is known as the R. I. P.



The Kaufmann monoplane—a machine with peculiarly shaped wings along the lines of Santos Dumont's Demoiselle.



Details of the tail of the Nieuport machine.



Two views of the tail of the R. E. P. monoplane, showing rudders, fin keel, and skid.

Landing skid and chassis of R. E. P. monoplane.

DETAILS OF CONSTRUCTION OF SOME NEW FRENCH MONOPLANES

Science in the Current Periodicals

In this Department the Reader will find Brief Abstracts of Interesting Articles Appearing in Contemporary Periodicals at Home and Abroad

The Harm Done by the "Harmless" House-fly

THE common house-fly, the *Musca domestica* of Linnæus, that insect which figures in fable and poetry, and is popularly regarded as a harmless, innocent, lively and interesting creature, which may be looked upon with indifference, or at most struck at with objurgation when too familiar, proves to be one of our worst enemies. Its relations to human life and sanitation are most important, and yet for years all efforts to bring the facts of its noxious existence properly to the attention of municipal authorities met with indifference or ridicule.

In a striking article published in the *National Geographic Magazine* by Mr. N. A. Cobb, accompanied by photographs made especially for that article by Mr. Cobb, the menace of the house-fly is instructively discussed.

"The fly's power to spread disease," says Mr. Cobb, "is a direct function of its powers of locomotion. It can fly considerable distances at a high rate of speed. It is quickly carried long distances by trains, boats, teams, animals, and man.

HOW THE FLY PEST SPREADS.

"It is possible to get a good idea of a fly's rate of flight in a number of ways. Flies come to ships newly arrived in port across considerable stretches of water. This we know, because a few hours earlier there were no flies on the ship. No communication has been had with land. The flies must have come on their own wings. Occasionally we see a fly follow a team or animal, easily keeping up a good pace. The wing muscles of a fly when weighed are found heavier in proportion than those of any bird so far examined. It is difficult to tire a fly out. Test this by trying to keep one constantly on the wing in a room and you will soon find you have no easy task. All this shows the fly to be no mean navigator of the air.

"Most of our diseases are caused by invisible germs These germs may be brought to us from some sick person by whatever is large enough to carry them and has the opportunity. Combine this fact with what every one knows about flies, and we see at once the tremendous importance of flies as carriers of human disease germs.

"The result of this simple piece of reasoning is so startling that it is often sidetracked by its own importance. It looks so incredible that we hesitate, distrusting our own logic. It seems incredible that men have gone on doing as they have done, and as they are still doing, if the facts are as they seem. The consequences of our reasoning seem so tremendous, we fear there must have been a mistake somewhere. And so we dismiss the idea.

"One way to disturb this false security is to interest people in the habits and structure of flies. The more we know about flies, the more clear it will become that they are among our worst enemies.

THE ANATOMY OF A FLY.

"The photographs illustrating this article have been designed with this end in view. Take for instance the view of the fly resting on glass and viewed from below. Look at the feet, and observe that each of them has two claws and two light-colored pads. The fly clings to rough surfaces by means of the claws, and to smooth surfaces by a combined action of the claws and pads. The fly's pads are covered with thousands of minute short hairs, sticky at the end. There is no suction—merely adhesion.

"The action of a fly's pads may be illustrated by means of a piece of sticking plaster and a few threads and small weights. Take a piece of sticking plaster half an inch wide and sew through it some short pieces of thread at intervals of half an inch, and knot the threads on the sticky side so that they cannot pull through. Stick the plaster to a dinner plate or other smooth object, and it will be found that if a small weight is attached to each thread the plaster will sustain in this way a considerable weight—that is to say, the sum of all the small weights is considerable.

"Now, remove the weights and attach all of them to one or two of the threads at one end. The plaster will promptly be torn loose. Acting on a portion of the plaster at a time, the weights can accomplish what they cannot accomplish when distributed along the whole surface of the plaster.

"This experiment illustrates roughly how the fly uses and controls its feet. Of course, in my illustration you can see just how the weights release the plaster from end to end. It is very difficult to make this observation on a fly, because the fly's pad is so small, and more particularly because the whole operation takes place in something like the fiftieth part of a second.

"Wonderful as the fly's pads are, they have their disadvantages, for stickiness and locomotion are not always strictly compatible.

THE CONSEQUENCES OF STICKY FEET.

"All his grown-up life the fly has to manage with sticky feet. Imagine our plight if the soles of our feet were sticking plaster, perennially renewing its stickiness! Whoever has experienced the sticky mud of certain regions will recall how the boots ball up and what a conglomeration one drags home from a ramble under such circumstances.

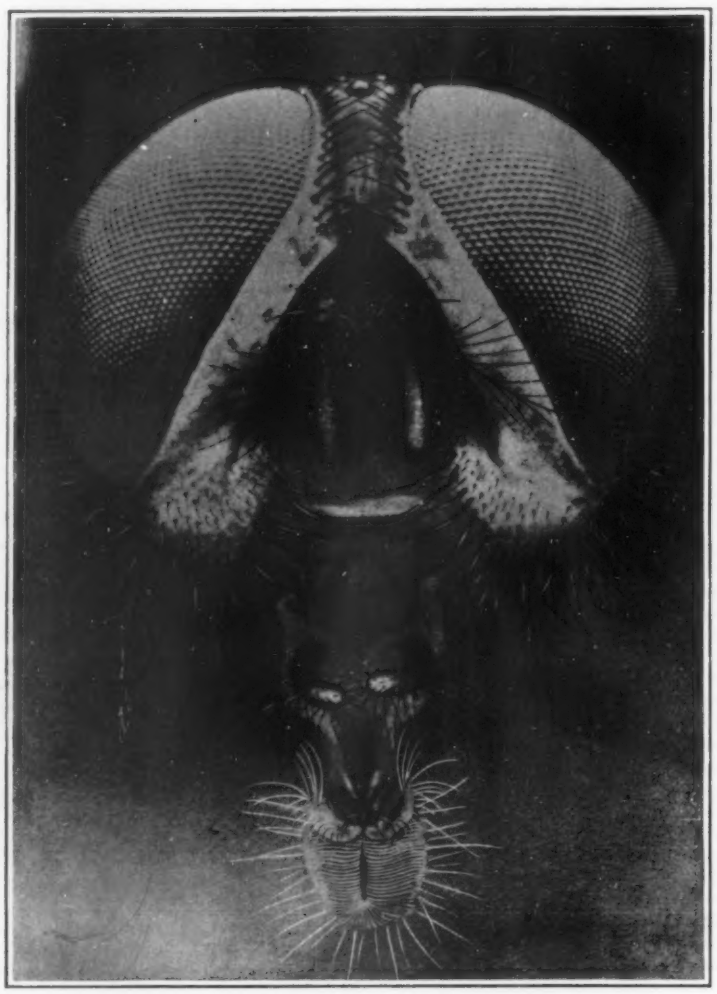
"To such inconveniences the fly is constantly subject, and it is this that has bred in him a habit of frequently preening himself, particularly his feet. These are constantly becoming clogged with adhering substances, and this contamination the fly must assiduously remove if his feet are to act properly in supporting him on slippery places. If this contamination is too sticky to rub off the fly laps it off, and it then passes off in his excreta.

"Thus it is that all sorts of microscopic particles are moved from place to place on the feet of flies. These particles are rarely of sufficient size to be seen with the unaided eye. Nevertheless, they are constantly present, and the amount of matter thus trans-

Photographs by N. A. Cobb. Copyright 1910 by the National Geographic Magazine.

Male house-fly resting on glass and seen from below.

In addition to two claws, each of the six feet is supplied with two light-colored sticky pads. Germs and spores stick to these pads and are thus carried from place to place with great rapidity.



Front view of the head of a house-fly.

The fly is one of the most highly organized of insects. The two large areas studded with thousands of facets are the compound eyes. The three simple eyes are seen at the top of the head in the middle.

ferred is relatively considerable on account of the fly's activity. When flies have access to diseased or rotten or foul matter, the transfers thus effected are dangerous. All sorts of minute organisms are spread in this way, including diseases of man, animals, and plants. It is impossible to go into details in this place, but it is only right to say that the imagination completely fails to grasp the far-reaching consequences of this transfer of germs and spores on the feet of flies."

A New Process of Briquetting Metal Shavings

RECENT developments in machine construction make it continually more difficult to obtain cast iron of sufficient strength. The introduction of large gas engines and the increasing use of superheated steam have been the principal causes of this difficulty, but even the cylinders of small motors, with walls only ⅓ or ¼ inch thick, are required to withstand, in testing, a pressure of 30 atmospheres. Marine engines, also, are continually developing more power and pressure, in proportion to their weight, and the task of the iron foundries is made more difficult by the competition of cast steel.

Hitherto castings requiring extraordinary strength have been made of Swedish iron and other special varieties, but a much less costly method of obtaining cast iron of the desired quality has lately been introduced. This result is obtained by adding to the fused metal shavings of iron, which have been formed into briquettes by great pressure, without employing any agglutinant or binder.

It has long been known that the quality of cast iron can be improved by the addition of iron shavings. In a process patented by George Whitney, which was in operation for several years, wooden or iron boxes filled with loose iron shavings were thrown into the furnace. The commercial success of this process was dependent on the existence of special conditions in the wood and iron markets, and the process was soon abandoned by the numerous foundries that had experimented with it.

The loose shavings were partly blown away by the blast and partly converted into slag, owing to the large surface exposed to oxidation. The total loss produced by these causes amounted usually to at least 50 per cent. Attempts were made to diminish the free surface by allowing the shavings to rust together in the air, but the masses thus obtained were so imperfectly conglomerated that they fell apart in the furnace into loose shavings, which suffered the fate described above.

The idea of compressing the shavings into briquettes with the aid of a binder then suggested itself, but the binder was volatilized in the furnace and the briquettes disintegrated into loose shavings.

Now Mr. Ronay has discovered a method of converting iron shavings, by intense pressure alone, into briquettes capable of withstanding great mechanical forces as well as the heat of the furnace. This process furnishes a market for iron shavings, which form a very annoying waste product in machine shops.

By means of hydraulic presses, the shavings are subjected to a pressure which is moderate at first, but is gradually increased to about 2,000 atmospheres, or 15 tons per square inch. In this way the shavings are first interlocked and finally welded together into solid briquettes without the use of a binder.

The addition of these briquettes to ordinary cast iron is much more beneficial than the addition of loose iron shavings. The behavior of the briquettes is the reverse of that of all materials hitherto employed, which appeared likely to diminish the proportion of carbon in the whole mass, because of their own small percentage of carbon, but which proved of little value because they absorbed carbon in fusing. Although the density of the briquettes is sometimes as great as 5.8, and they are too compact to suffer much loss through oxidation, their texture is open enough to allow the carbon which they contain, in the form of graphite, to be burned out above the zone of fusion. The carbon thus lost is not wholly regained in fusing, so that a considerable net decrease in carbon results. The beneficial effect of the briquettes is due partly to this absolute decrease in carbon, and partly to an increased loss of silicon, which prevents the deposit of graphite in coarse particles and large quantities.

The briquettes are useful for various purposes in addition to the casting of iron. By adding substances calculated to improve the quality or facilitate the working of iron, briquettes of any desired composition can be made. A material of more uniform composition than pig iron can be obtained by mixing shavings of gray cast iron of different sorts. The Borsig firm uses briquettes made of mixed shavings of cast iron and steel in casting engine cylinders.

In all metallurgical operations in which scrap steel is used, briquettes of steel and wrought iron shavings would form a cheap and efficient substitute. Objects in which great strength is not required can be forged directly from wrought iron briquettes.

Borsig has made a series of experiments, with the following results: White iron was obtained by fusing briquettes of gray cast iron in a covered crucible, or in a coupola furnace. The loss of weight in fusion was found to be about 50 per cent for loose iron shavings, 2½ to 3 per cent for pig iron, 8 to 10 per cent for pure cast iron briquettes, and 3½ per cent for a mixture of 80 parts of cast iron briquettes and 20 parts of pig iron. Hence it may be assumed that the addition of the small proportion of briquettes required in foundry work would not appreciably increase the loss of iron.

Experiments on the strength of the final products showed that the resistance to bending stress increases in proportion to the percentage of briquettes added, while the elastic limit remains nearly constant. The tensile strength and resistance to fracture by blows also appear to be increased by the addition of briquettes.

The Borsig and other large German foundries have already cast, from iron fused with an admixture of briquettes, hundreds of engine cylinders which show great strength and an internal surface of excellent grain.

Large iron works could profitably make their own briquettes, while small establishments could have their shavings briquetted in special factories, which would also purchase shavings from machine shops and keep a supply of briquettes for sale.

Dr. A. Gradenwitz, who gives the foregoing account in *Prometheus*, adds that the Ronay process can be employed with advantage for briquetting shavings of other metals than iron, especially such valuable metals as bronze and aluminium. Hitherto such shavings have been thrown into the smelting furnace in the loose state. In consequence of the great extent of surface exposed, 8 per cent of the bronze, 20 per cent of the brass and more than 50 per cent of the aluminium are lost by oxidation and the metal retains particles of oxide which diminish its strength. If the shavings are briquetted the loss is greatly diminished and the fused metal is perfectly homogeneous, so that it can be used directly for important castings, such as safety valves, high pressure pumps, etc. Briquetting also gives a better control of the material used.

The briquetting process can be applied to ores, sawdust, coal dust and countless other materials, and it appears destined to give value to many waste products. Sawdust, for example, can cheaply be converted into excellent fuel.

Briquettes of iron shavings have a loose texture which shows the separate shavings, while briquettes of easily fusible metals and some other substances can scarcely be distinguished from homogeneous solid blocks.

A Remarkable Vegetable Poison

RECENT experiments have demonstrated the existence of a poisonous substance of very remarkable qualities in the seeds of so well known a plant as the ricinus, or castor-oil plant, a common ornament of our gardens.

It has long been observed that these seeds frequently proved fatal to animals who fed upon them, or to children who swallowed them by accident, but the toxic principle has first been isolated, as yet in very impure form, by Prof. Robert of Bostock, the process consisting of maceration in a solution of sodium chloride. Even now the pure preparation cannot be obtained because of the small amount of the poison and the difficulty of separating it from associated albuminoids.

Even so its terrible potency is shown by the figures of Prof. Ehrlich of Frankfort-on-Main, who estimates that one gramme of ricinus is sufficient to kill one and one-half million guinea-pigs. This tremendous death-dealing power surpasses that of all other poisons known to us as enemies of living matter; such, for example, as strychnine and cyanide of potassium.

According to Dr. B. Rewald in *Kosmos*, this quality alone would make the new poison of interest to scientists, but this interest is increased by the discovery of a very unique "poison stability" in this product. That is, if a quantity of poison be injected into an animal insufficient to kill but enough to cause severe illness, the animal upon recovery is capable of enduring a second dose sufficiently large to kill a fresh animal instantly. Moreover, the dose may be increased gradually a thousand-fold or even ten thousand-fold without causing unfavorable symptoms.

This can, of course, be done to some extent with other poisons, such as arsenic and morphine, but in these the possible dose always remains in very moderate proportion to the death dose, and corporeal disturbances are always manifested, while these are absent with the ricinus.

Another striking peculiarity is that in the blood of these immunized animals an antitoxin is formed. This likewise has not yet been isolated in pure form, but it has been possible to work with it as a fixed quantity.

When this antitoxin, found in the blood serum of an immunized animal, is injected into a freshly poisoned animal, it will prevent the development of toxic symptoms, and will also cure one which has already become ill. A similar action is of course well known in the case of bacterial infections, such as diphtheria, tetanus, etc.

Moreover, this vegetable poison shows another similarity to bacteria. We know that the blood serum of animals which have been previously treated with a bacterial poison possesses the property of agglutinating bacteria of its own sort floating in some medium, such as, for example, water—a property not possessed by normal blood serum.

Ricinus in solution possesses a like property, since within a short time it causes the red corpuscles to form a gelatinous clotted mass.

But different kinds of blood vary in susceptibility to this action. For example, pigeon's blood and dog's blood show the reaction immediately, while it is absent or very slight in that of goats, lambs, and cattle.

Besides ricinus there are some rare seeds which contain bodies exhibiting similar properties.

It is certainly very singular and noteworthy that on the one hand highly developed plants and on the other hand the lowest forms of life should produce poisons which so strikingly resemble each other in their fatal qualities, in their creation of immunity, and in their power of agglutination.

Meat Scarcity and Meat Preservation

EVEN in uncivilized times and regions man has been taught by experience to provide against famine by preserving food in seasons of abundance. Although successful methods of preservation have been in use for centuries in all parts of the world, no really rational process could be developed before the cause of putrefaction had been discovered in bacteria, and means of preventing the growth of those injurious organisms had been found by experiment. The art of preserving food, including meat, which is especially prone to decay, has been so highly developed, chiefly by the labors of the bacteriologists, that food preservation has become an important factor in maintaining the balance between demand and supply.

The International Hygienic Exhibition, to be held in Dresden this year, will devote a large amount of space to this subject of paramount economic, as well as hygienic, interest, and will reserve a special section for exhibits illustrating the theory and practice of meat preservation. This information is given by the journal *Hygieia*, the official organ of the exhibition, which summarizes, as follows, the various general methods of preserving meat.

These methods are four: desiccation, cooling, heating and sealing, and treatment with chemical agents. Drying is a very old and good method, which is still practised by primitive races and, to some extent, in civilized countries. The method of drying meat which is used by the Laplanders, for example, will be illustrated at the exhibition. The special advantage of drying is that the meat loses none of its nutritive value, as it is neither leached nor chemically altered. The efficacy of the widely used process of salting and pickling, especially dry-salting, depends partly upon the fact that salt and saltpeter extract water from the meat and thus prevent the growth of bacteria, but these salts also destroy the bacteria by chemical action. In smoked meat, likewise, the putrefying organisms are killed by the creosote and other ingredients of the smoke.

The preservation of meat by cold storage is now practised on an immense scale, with the aid of elaborately equipped and carefully managed refrigerating and cold-storage rooms, which will be well represented at the exhibition. Frozen meat can be carried around the world without losing any of its freshness, and cities can be abundantly supplied with fresh meat in the hottest weather.

Of still greater practical importance is the method of preserving meat by heating or cooking it, and sealing it in air-tight cans. Not only have the commercial canned meats and meat products become very popular, owing to their cheapness, convenience, and palatability, but the small and very efficient forms of sterilizing apparatus, which are now made for household use, are beginning to appeal to many persons who are still suspicious of commercial canned meats, despite the skill, care, and governmental control which are applied to their production. Any householder can now preserve meat in perfect condition.

As the use of canned meat increases, the often recurring rise in the price of meat will rapidly lose its terrors, and gradually become imperceptible. When strict control of food supplies shall have been established by every government, and the restrictions which now hamper international commerce in meat shall have been abolished, all local and temporary variations in production will be compensated by imports and exports.

Correspondence

Solar Energy

To the Editor of the SCIENTIFIC AMERICAN:

Just a few lines concerning the article in the SCIENTIFIC AMERICAN for January 21st on the "Utilization of Solar Radiation and Wind Power."

It was somewhat surprising that the leading American scientific journal should give space for an article and full-page illustration on such an impossible proposition as this.

The inventor of this interesting device, Mr. R. A. Fessenden, proposed to cover an artificial lake with thick glass. He expects the sun's heat will convert the water in this lake into steam with which to drive an engine! Now any schoolboy knows that the rays of the sun can never raise water to the boiling point of 212 degrees without the use of condensing mirrors or lenses.

The solar steam engine is not practical, and never will be, owing to the expensive machinery of such a plant and the small and erratic nature of the power obtained therefrom. There have been described in the SCIENTIFIC AMERICAN several solar engines. One of these, located in California, I think, uses a huge paraboiic mirror to converge the sun's rays upon a small boiler placed in the center of the apparatus. A train of gears and clockwork is used to keep the whole affair constantly pointed at the sun as it travels from east to west across the heavens. A steam pipe carries the steam thus generated to a small engine, which gives 8 or 10 horse-power. This machine undoubtedly works, but the mechanism is complicated, delicate, and costly, and probably requires the constant care of an engineer. It is probably far from an economical power plant. Of course, it operates only when the sun shines.

Another device of similar nature, instead of using water in the boiler, uses ether or some other liquid with a lower boiling point than water. This obviates the use of mirrors, but the loss of the generating liquid must be considerable, even with the use of the best condensers, while the power obtained in this way is small in quantity and uncertain in nature.

Mr. Fessenden's second scheme, which consists in using windmills to pump water into storage tanks, from which it is drawn to operate turbines and generators is more practical than the solar device. But why not drive electrical generators directly from the windmills, and store the power thus produced in efficient storage batteries? This is already being done in several places, and for small plants seems to work fairly well. It is certainly much less wasteful of energy than the water-storage-turbine system would be.

By the way, what has become of the page for correspondence formerly contained in your esteemed paper? This was a very interesting feature, and I trust is not going to be discontinued. *Your paper is certainly greatly improved since the new year, and your efforts are sure to be appreciated by your army of readers.* DEWEY C. CANFIELD.

East Canaan, Conn.

Longer Piers at New York

To the Editor of the SCIENTIFIC AMERICAN:

In your article of February 4th, on the "Longer Piers" controversy at New York, and the editorial on the same subject, you cover the ground exceedingly well but for a few points which should not be neglected, and which require no argument.

The origin of the controversy was as follows:

One of the great foreign companies, operating to this port, came to the government at the eleventh hour saying that they were just completing a great new ship and wished to encroach 100 feet on the fairway for her accommodation. The present pier head line was established by competent government engineers for the best interests, not only of the port, but of the river and of the whole country, and its establishment was to safeguard the future.

Twice before this, corporate and local interests have sought to encroach beyond this line and twice they have failed and made other satisfactory arrangements. Such arrangements can be made perfectly well now, and the petitioning companies and the Department of Docks and the government engineers all know it. Below West 41st Street and above West 44th Street are considerable stretches available for piers. The stone bulkheads are not yet built in these places and the general character of what piers are there is more or less temporary. By keeping the bulkhead about where the old bulkhead was and now is, and by skewing the piers a little, they could easily be made 1,000 feet long.

The talk of these larger new ships going to any other port than New York is hardly worth a busy man's thought. New York is the only place that can give commerce of the quantity and class required. If New York should get 100 feet extended into the fairway the Jersey Commission would demand the same thing. Larger ships are surely coming if past records show anything, and larger ships certainly need a commodious harbor. Again, besides the larger ships the aggregate commerce will be immensely larger in twenty years, and it would seem criminal to congest the harbor or take away any of the lee-room which it now enjoys.

Comparison of Liverpool or other harbors is meaningless without comparing also the character of the harbor traffic, and in no other harbor of the world can such an intricate, criss-cross, complicated traffic be found as in New York.

We have the best harbor in the world, and it is the business of the engineers of the government to maintain it. They are responsible to no parties or corporations or private interests, and the measure of their responsibility rests only in their own judgment of the future welfare of the port, the river and the country. By holding up their hands we will be doing an act for which the future will bless us.

New York, N. Y. BOATMAN.

A Mechanical Problem of Puzzling Interest.

To the Editor of the SCIENTIFIC AMERICAN:

Will you kindly submit to the readers of the SCIENTIFIC AMERICAN the following mechanical problem, which I believe to be of some puzzling interest, even if it looks so simple? I have not seen two persons that give the same quotation or figure it out in the same way:

I, II, III are three distinct problems, and may represent three independent sets of rollers or three sets of planetary gear movements. *A*, *A'*, *A"* are internal gears. The figures (111, 25, 61) (111, 37, 37) and (111, 45, 21) are the number of teeth upon the different gears.

The questions are:

I. If internal gears *A*, *A'*, *A"* are held stationary, how many revolutions are required of gears (*C*, 61),

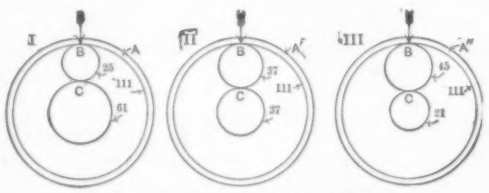


Diagram of mechanical problem.

(*C*, 37), and (*C*, 21) to carry satellite gears (*B*, 25), (*B*, 37), and (*B* 45) one revolution around internal gears *A*, *A'*, *A"*, or back to the starting point marked by arrows?

II. If *vice versa*, gears (*C*, 61), (*C*, 37), and (*C*, 21) are held stationary, how many revolutions are required of internal gears *A*, *A'*, *A"* to carry satellite gears (*B*, 25), (*B* 37), and (*B*, 45) one revolution around stationary gears (*C*, 61), (*C*, 37), and (*C*, 21)?

III. Which is the simplest solution or key to the problem?

Chicago, Ill. JOSEPH DE MARTINO.

Spread of the Rural Telephone Movement

THE movement for communication among farms and for better connections between rural and city districts has increased wonderfully within the past few years. To those who are ignorant of the real statistics, the figures of the latest telephone census are amazing.

For the period from 1902 to 1907 the number of rural telephone stations in the entire country increased 449 per cent. In 1902 there were but 266,966 rural telephone stations in the United States; five years later there were 1,464,773.

The census figures show that the South has a great share in this development. The increase in the South Atlantic States was 469 per cent, and in the South Central States it was 367 per cent. The actual figures, however, mean more than percentage, showing steadily increasing telephone development in all States.

Wherever the telephone has gone it has brought with it better living, an increase in the productiveness of the farms, and money-making opportunities for the agriculturist that were not dreamed of before. But when one considers that in this five-year period the number of rural telephones jumped from 94 to 5,073 in Maryland; from 270 to 24,874 in Oklahoma, and from 159 to 12,403 in Arkansas, the manner in which telephones were popularized and raised from the station of a rich man's luxury to that of an every-day necessity of all the people can be readily understood.

The census, though its results have only recently been published, does not bring the actual conditions quite up to date. No figures are available for the year and a half since December 31st, 1907, but the increase in the number of rural telephone stations has been even more marked than in the five-year period to which the statistics refer.

The reasons for this growth are not hard to find. Life on the farms used to be irksome—distances were so great. The telephone is the annihilator of distance. As one farmer expressed it, "I am next door to everybody I want to talk to. That telephone puts my isolated farm in the heart of things." Roosevelt's Country Life Commission designates the telephone as one of the foremost influences making for the solution of the rural problem.

When it is considered that the average farmer can install this advance agent of development at a cost less than the present return from a bale of cotton, or thirty bushels of wheat, it is not difficult to understand why the rural telephone is making great strides throughout the entire country.

The part which the farmers themselves have taken in the telephone movement makes it one of considerable importance. It is a fact that for very small trouble and expense a group of neighboring farmers can buy, build, and maintain a serviceable telephone system. The work of installation is not so very different from ordinary fence-building operations about the farm. Equipment conforming with the best recognized standards is at the disposal of progressive rural citizens for their telephone building.

It is not an unusual sight to witness gangs of farmers at work on the roads, erecting poles, stringing wires, and installing the instruments in the farmhouses along the countryside. This work is usually done on a co-operative basis.

Often some sort of an organization is formed. Sometimes six or eight neighboring farmers start the movement. In case there are as few as this, no switchboard is necessary. Construction and maintenance are of the simplest nature. A single pair of wires will suffice, and the "party line" system is found the most convenient and useful. As demands grow and the little rural companies branch out, extensions are made, and, usually, connection through trunk lines with the rest of the world.

It is interesting to note that the adoption and development of the telephone in a rural locality is attended by a minimum of expense. Of all the agencies that help bring greater opportunities to the farms—the goods road movement, railroad extensions, the rural mail delivery, and the farm telephone—the least costly, and, because it reaches the largest number, the most important, is the telephone.

No longer does the farmer consider "the voice in the box" as one of the mysterious things for the city fellow to fool with, and for the farmer to let alone.

The ease and small cost with which the neighborhood telephone line can be constructed appeals to and interests him.

Manufacturers of telephones, and operating telephone companies generally, publish books and pamphlets describing "How to Build Rural Telephone Lines." These publications treat the subject in a simple and comprehensive way; they are profusely illustrated in a way which enables any one with ordinary intelligence to construct a practical telephone line of a limited number of stations.

Increasing Use of Automobiles by the Farmers

ACCORDING to the Bureau of Statistics at Washington, a careful compilation of all available returns has shown that last year the farmers of this country purchased 26,000 automobiles—an increase of 85 per cent over the previous year and more than 400 per cent over the number of cars purchased by them in 1909. The farmers of the South and West especially have come to realize that the modern auto cars save both time and money for them, besides being put to use in various ways upon the farm. It is no longer a luxury, but a necessity, and consequently all who can possibly afford it are investing in machines.

An Agricultural Motor Competition

THERE will be an agricultural motor competition at the Canadian Industrial Exhibition, which is to be held in Winnipeg, Canada, from July 5th to July 22nd, 1911, and which will be open to the world. The engineers in charge will be Prof. A. R. Greig and L. J. Smith.

Paris Exposition

THERE is some talk of having an exposition at Paris in 1920. The senatorial commerce and industry committee lately voted in favor of the project. It is intended to bring the matter before the Minister of Commerce and to have Parliament take some action thereupon. However, it is not at all certain that the project will be carried through, as there is considerable opposition to it.

Dynamite on the Farm

Explosives as a Substitute for Ax, Plow, and Spade

By Willard Young

DYNAMITE has been employed for some years in clearing new land of stumps, boulders, rocks and standing trees. The redwood, fir and pine stumps of the Pacific Coast are blasted with low grade, slow acting dynamites. The amount required depends on the size of the stump, the kind of soil in which it stands and the nature of the roots, and generally ranges from ten pounds to five hundred pounds. Sixty per cent quick acting dynamite is necessary for cypress stumps in swamps, while thirty per cent to forty per cent slow acting dynamite usually does best with oak, pine, elm, hickory, chestnut and the general run of stumps.

Almost all vegetation is, of course, directly influenced by the depth, moisture condition and ingredients of the fertile surface soil. Under the surface soil at a greater or less depth and in varying thickness is found the subsoil, which often cannot be penetrated by moisture or plant roots, and which at best yields but little plant food in its compact state. When the subsoil is quite impervious and underlies low ground, swamps or ponds exist above it. If such subsoil occurs under perfectly flat and level ground, the surface is generally marshy. Under rolling land, compact subsoil is not a serious restriction to plant growth, provided the alluvial surface soil be deep. If it be thin or shallow, the land will not retain sufficient moisture to supply the plants through dry weather. Again, thin surface soil is quickly eroded from hilly land. In some places where the surface soil on rolling land is thin, efforts have been made to retain it by throwing up low ridges or dikes to check the wash of heavy rains.

The only satisfactory method yet devised of upheaving and disrupting subsoil is to blast it with dynamite. Swamps are drained by drilling several holes in the deepest part down through the impervious subsoil and exploding in the bottom of these holes from three to fifteen pounds of 30 per cent or 40 per cent dynamite having good water-resisting properties, semi-gelatin or gelatin dynamite being best for this work. When properly done this blasting shatters the subsoil so that it affords permanent drainage and so that the swamps do not form again.

Marsh land is recovered by ditching. The ditches and drains are excavated by exploding charges of approximately a half pound of 50 to 60 per cent quick acting dynamite in holes put down in a line and spaced approximately two feet apart. Only the middle charge in the row is primed, and the explosion of this charge causes the entire row to explode. In this way a ditch three feet deep, five wide and of any desired length can be excavated instantly without any shoveling. Ditches fifteen feet wide are excavated by exploding the dynamite in three parallel rows of holes.

Felling a tree with dynamite.

Subsoil under land is broken up with quarter-pound to half-pound charges of 25 per cent to 30 per cent slow acting dynamite exploded in holes sunk from two to four feet at regular intervals. The depth and spacing of the holes and the size of the charge depend on the thickness and condition of the subsoil. Experiments in subsoil four feet thick under a foot of surface soil have been made by sinking pits midway between holes spaced at various distances. These experiments have shown that a half pound 25 per cent slow acting dynamite exploded in the holes driven down to six inches above the bottom of the clay subsoil will properly break and crack the subsoil to a distance of eight or ten feet. The proper spacing for the holes in this ground is therefore fifteen to twenty feet. Holes fifteen feet apart average about one hundred and ninety-four to the acre, and holes twenty feet apart average about one hundred and eight to the acre. The cost of labor and explosives to blast an acre of this kind of subsoil is from fifteen to twenty dollars. In some places land on which nothing of value could be grown has been transformed into excellent farms by subsoil blasting, and in many other places it has increased crop yields from twenty to fifty per cent.

Dynamite is also used extensively to break up the subsoil in orchards. Here holes are put down four or five feet deep, midway between the trees, and the explosion of a half pound of 25 per cent or 30 per cent slow acting dynamite in these holes opens the subsoil so that there can be no root binding. The explosion also destroys grubs and beetles and tends to prevent wet rot and other fungus growth. In some places, where orchards are failing, it is the custom to explode a charge of five or ten pounds of powder about ten feet deep directly under the tree.

When young trees are planted the hole is dug with a quarter pound or half pound of 30 per cent dynamite. This loosens the surrounding soil so that the tree roots can spread extensively and also grow deep into the subsoil for moisture. In some ground trees planted in blasted holes are almost twice as large when a year old, as those planted in holes dug by hand.

Dynamite is also used on the farm to excavate trenches for tiling or for pipe lines, to dig cellars and foundation trenches, to grade and ditch roads, to sink wells, to clear ice from watering places for stock and to break ice gorges in streams, to dig holes for poles or for fence posts and to split logs for fence rails, cord wood, etc.

Boring the holes for a dynamite charge.

A series of twelve 3-inch holes, placed 20 feet apart and filled with dynamite, produced this effect after explosion.

Blasting out a stump.

Land ready to be cleared of stumps.

This is not a row of trees, but a blast of dynamite. The object of the blast is to make a ditch.

Punching holes for ditch blasting, which is just as easy as it looks and a great improvement on the shovel.

WHAT THE FARMER CAN DO WITH DYNAMITE

Creating New Animals and Plants

Mendelism and the Farm

By W. J. Spillman

Bureau of Plant Industry, United States Department of Agriculture

IN the practical affairs of life practice usually precedes science frequently by many years. Then the scientist discovers the principles which underlie practice, and thus enables us to improve on former practice. Much improvement in domesticated animals and considerable improvement in farm crops was made before we discovered any of the fundamental principles involved. Important discoveries in this line began about twelve years ago. It is true the most important of all these discoveries was published in 1865, but it was in advance of its time and was forgotten until rediscovered by several men about 1899 to 1901. The art of breeding, both of farm crops and of farm animals, may now be said to be an applied science. The principles which have been discovered will be stated here in the briefest possible form.

SELECTION.

The old method of improving crops and animals was by selecting the best individuals for breeding purposes. It was thought that this produced actual improvement in the individuals selected. We now know, however, that it does not do this, but it does eliminate inferior strains and thus raises the general level of excellence of the breed. Much improvement has been made in varieties of wheat, potatoes, corn, and in all of our improved breeds of farm animals by selection without any attempt at cross breeding of different varieties. But it must be remembered that the improvements thus made can accomplish only the segregation of the best individuals or combinations of characters existing in the population with which we began the selection; it cannot produce any improvement beyond that point.

It frequently occurs that two different varieties or breeds, each possessing excellences and defects, can be crossed and a new variety or breed made combining the excellences and eliminating the defects of the breeds or varieties used in the cross. It is only during the past dozen years that this has been known, and the reason for it understood. It is true that Gregor Mendel discovered this principle and published it in 1865, so that it is now known as Mendel's law; but no practical use was made of it until it was rediscovered a third of a century later.

There are three important principles involved in Mendel's law. The first is the principle of dominance. Figs. 8 and 6 illustrate this principle. In Fig. 8 a bearded wheat with lax heads, shown at the right, was crossed with a beardless Club wheat, shown at the left. The hybrid, which is shown between its parents, has a Club head and no beards. Characters which show in a hybrid while their opposites do not show are said to be dominant, and the characters which do not show in a hybrid, although present, are said to be recessive. In Fig. 6 a polled, or hornless, animal is shown. One of its parents had horns, the other did not. It is seen that the poll character is dominant and the horn character recessive. This principle is of great importance, especially in producing new varieties of potatoes, fruits, etc., which are propagated by cuttings. A hybrid, when it reproduces from seed, does not reproduce true to type; but when reproduced from cuttings, it reproduces perfectly true to the type of the hybrid.

SECOND GENERATION OF BROWN X BLUE EYES.

Br = Brown; Bl = Blue.

1. Br fr. F. and Br fr. M. = BrBr.
2. Br fr. F. and Bl fr. M. = BrBl.
3. Bl fr. F. and Br fr. M. = BrBl.
4. Bl fr. F. and Bl fr. M. = BlBl.

The second principle is that known as the law of segregation. Referring to the animal shown in Fig. 6, which is a hybrid between a horned and a polled breed, according to the law of segregation, this animal will transmit the horn character to half its offspring and the poll character to the other half.

The third and most important principle which Mendel discovered is known as the law of recombination. It is a result of the law of segregation and the further fact that each pair of characters segregates without any reference to any other pair. According to the law of recombination, the second generation of a hybrid, if sufficiently numerous, will present every possible combination of the characters of the original parents. The foregoing table shows this law in the case of eye color in human beings. Both parents in this family: (1) Those inheriting brown eyes brown eyes and blue eyes. Brown eyes being dominant over blue eyes, these parents are both brown-eyed. There are four classes of children which may appear in this family: (1) those inheriting brown eyes from both parents; these will be pure brown-eyed; (2) those inheriting brown eyes from the father and blue eyes from the mother; (3) those inheriting blue eyes from the father and brown eyes from the mother; these two classes will be alike and like the parents; (4) those inheriting blue eyes from both parents, and they will be the only blue-eyed children in the family. Thus in such a family, on the average of a large number of cases, one fourth of the children will be blue-eyed.

APPLICATION OF MENDEL'S LAW.

Many important applications of the principles above enunciated have been made in producing new varieties of farm crops and new breeds of animals. Many other applications can be made.

New Varieties of Wheat.—Eastern Washington, eastern Oregon, and northern Idaho is one of the great wheat-growing regions of the world. The farmers in that section in the early day tried every variety of wheat known in order to find varieties adapted to their conditions. In the vicinity of Pullman, Wash., where the State Experiment Station is located, up to 1899 the farmers had found only one variety that was satisfactory, and it had some serious faults. The difficulty with practically all the varieties tried, except this one, was that the straw was weak, and when a rain storm came after the wheat had grown up in the spring it would blow down. Again, except this one variety, when the grain got ripe the chaff would

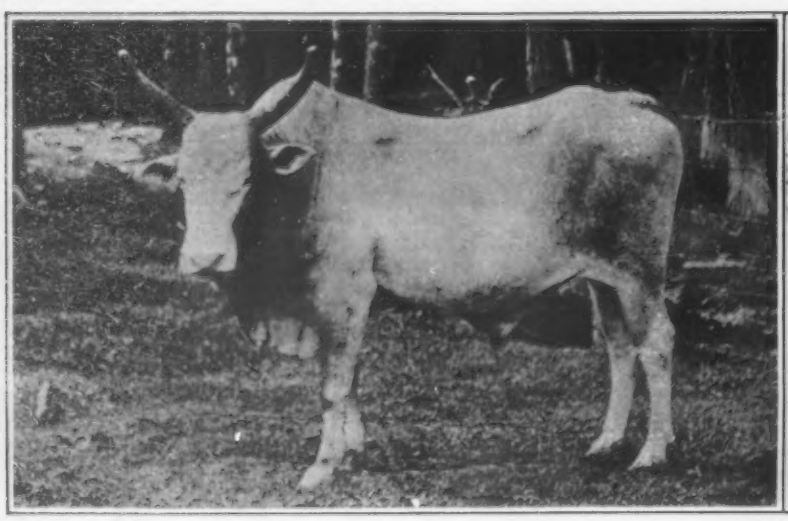


Fig. 1.—Brahmin bull owned by Georgia experiment station and used in producing immunity to Texas fever in southern cattle.

Fig. 2.—Hybrid steers produced by crossing Short Horns and Herefords. These hybrid animals make better feeders than pure breds.

ANIMALS AND PLANTS MADE TO ORDER

spread apart and let a great deal of the grain fall out, especially if the weather was windy. But the Little Club variety would stand up and hold its grain for a month or more after it was ripe. It has been found in that country that when wheat is sown in the fall, if it goes through the winter without injury, it will yield 50 per cent more than if sown in the spring. Hence although the Little Club is a spring variety it was nearly always sown in the fall. On an average of about every third year it would freeze out and have to be resown in the spring. The farmers insistently demanded a winter wheat that would stand up and hold its grain. The writer was at that time Agriculturist to the State Experiment Station of Washington, and attempted to find a winter wheat of this character. Hundreds of varieties were obtained from all over the world, but none of them would stand up and hold its grain. At that time Mendel's law was not known, but in the hope of producing a combination of the good characters of some of the best winter wheats and the Little Club spring wheat numerous crosses were made. Fig. 3 shows Prof. E. E. Elliott, who was at that time the writer's assistant and who later succeeded him at the Washington Sation, making the crosses in the field. He is here transferring the pollen from one variety of wheat to the stigmas of another variety. The first generation hybrids were harvested in the summer of 1900. The seed of each hybrid plant was kept separate and sown by itself in the fall of 1900. While these wheats were heading out the next year, the writer discovered the law of recombination. He found that in every row every possible recombination of the old parent characters was present.

For instance, Fig. 10 shows the Valley and Little Club varieties six first generation hybrids of these two varieties, and the types which each of these six hybrids produced in the second generation. At the top of the figure the small head at the left is the Little Club variety, the next is the Valley. The left half of the picture shows the results when pollen

(Continued on page 184.)

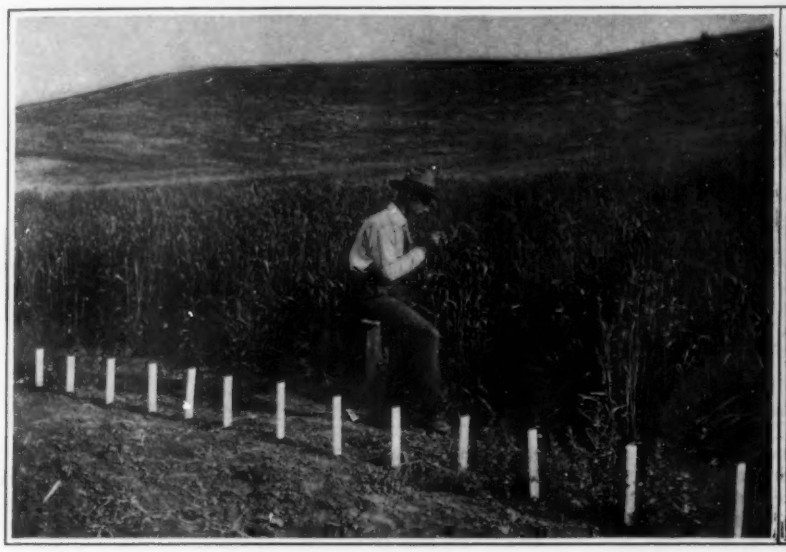


Fig. 3.—Hybridizing wheat. Transferring pollen of one variety to the stigmas of another.

Fig. 4.—A Holstein bull. Note the characteristic white stripe over the hips and just behind the shoulders, which frequently occurs in this breed.

Fig. 5.—A pure polled animal of the Hereford type produced by the application of Mendel's law of recombination.

Fig. 6.—A cross-bred animal having a horned dam and a polled or hornless sire, illustrating dominance of poll character.

Fig. 7.—A Hampshire pig, showing the white belt which is characteristic of this breed. Breeders have not been able to fix this belt.

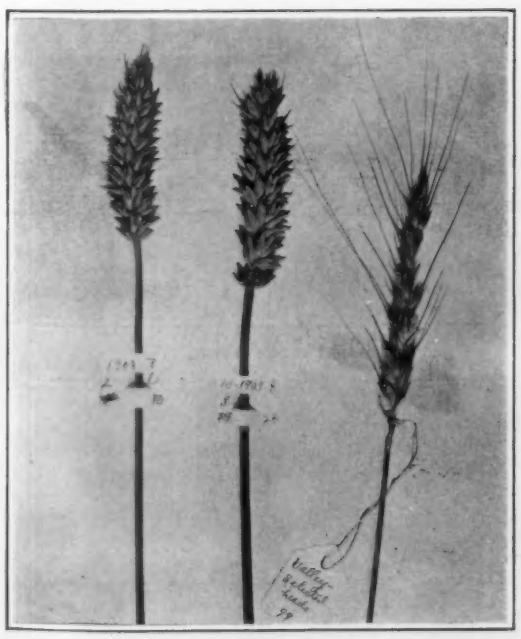


Fig. 8.—Hybrid between Valley and Little Club. The Valley type is shown at the right, the Little Club at the left, the hybrid in the middle.

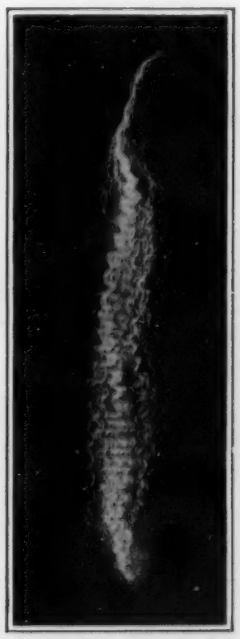


Fig. 9.—Hogget wool, worth three or four times the price of ordinary wool.

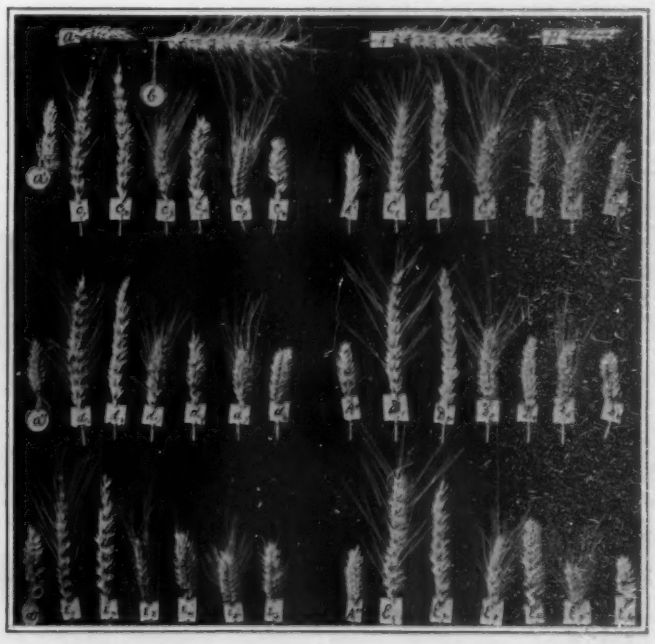


Fig. 10.—Parents and first and second generation hybrids of wheat produced at the Washington State experiment station. In this cross valuable new varieties of wheat were produced.

HOW ANIMALS AND PLANTS ARE CREATED THAT NEVER EXISTED BEFORE

Cement on the Farm

A Material of Many Uses

By Ralph C. Davison

FARM owners and operators are appreciating the economic value of concrete more and more every year. It is not only the large farmer who can use concrete to advantage, but the small farmer can do so as well.

The use of concrete on the farm is practically unlimited, therefore we can only mention a few of the many uses to which it can be put. These, however, may seem many to the uninitiated, or to those who have given but little thought to the subject.

Among the most popular uses are the making of fence posts, walks, barn floors, watering tanks, lawn rollers, drains, foundation posts and floors for corn cribs, windmill foundations, root cellars, retaining walls, culverts and bridges, dams, silos, cow barns, stepping blocks, hot-houses, hot-house benches, hens' nests, poultry houses, smoke houses, granaries, hitching posts, porch columns and foundations, garages, barns, hog troughs, piggeries, dairy houses, and ice houses.

What makes concrete to-day more popular than ever is that it is an excellent substitute for lumber, the cost of which within the past few years has reached almost prohibitive figures. Therefore it is only natural that a material which has as many advantages over lumber should appeal to the farm owner as strongly as it does.

Aside from its moderate cost, concrete is more durable and sanitary than wood, its maintenance cost is practically nothing, and it is absolutely fire-proof. Thus the fire risk, excepting the contents, is entirely eliminated where it is used. Another point in favor of concrete may be found in its ornamental possibilities. Being of a plastic nature, it can be molded into plain or ornate designs as fancy dictates, and if the owners artistic taste runs to color, he may insert, here and there, a colored tile. This will break the monotony of even the plainest design, and will also add individuality to the work. When making hitching posts, horse blocks, retaining walls, gate posts, etc., effective surfaces may be obtained by placing varied-colored field stones near the sides of the mold. Then when the mold is removed these will show plainly on the face of the work. Surprisingly beautiful and attractive results can be obtained in this way with but little skill and ingenuity.

The cost of concrete is trifling, for in most instances sand and stone suitable for the work can be found on one's own farm, or if not, some nearby farm will have a good deposit of sand or gravel which one can get for the hauling. Therefore the only cash outlay required is that for the cement, and this is sold for a remarkably low figure. Just to give the reader some idea of how easy it is to make useful things in concrete, a few general instructions are given below.

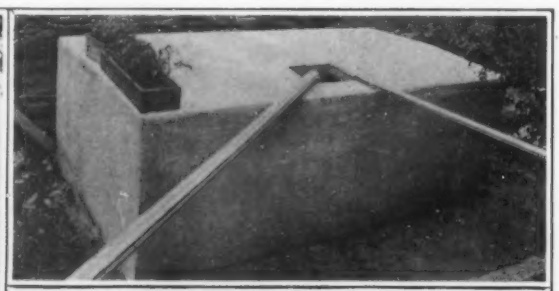
For instance, we will take a watering trough. Every farmer knows the necessity of a good watering trough for his stock. It is probably one of the most useful and essential devices about a farm, and when made of concrete it not only presents a pleasing appearance, but is also practically indestructible. Watering troughs can be made with or without reinforcing. If reinforcing is used, the walls of the trough can be made thinner. The forms are simple to make. As a rule, it is best to make the trough where it is to be permanently located; for if not, on account of its weight, one will have trouble in moving it around. The first thing to do is to build a bottomless wooden box, the inside dimensions of which must correspond to the outside dimensions of the finished trough. Locate this on the ground where the trough is desired, and tamp the earth, which now forms the bottom of the box, down good and hard. On the ground thus tamped deposit concrete for a depth of about six inches; this will form the bottom of the box or trough. After tamping the concrete, and while it is still soft and wet, set the inner form on it. This consists of a box, the outside dimensions of which are the same as the desired inside dimensions of the finished trough. Oil or grease the outside of this mold well, and be careful to set it central, so that all four sides of the trough will be uniform in thickness. Then fill molds, and level off flush with the top. Let the forms remain in place for two or three days before removing so as to give the concrete a chance to become hard. The principal precautions to take in building a concrete water tank are to see that a rich mixture is used, that it is poured in a moderately thin consistency, and that the forms are completely filled in one operation.

A good heavy roller is always useful about a farm. For a trifling cost an excellent concrete roller can be made. A piece of sheet iron can be used for the outer form. It should be formed into a circle, and held in shape by wrapping it firmly with light-weight wire. In the center of this circular form is placed a gas pipe, through which the shaft can be inserted when the roller is complete. After the form has been set up and the gas pipe properly centered, it

Concrete hens' nests and mold.

Circular trough and wooden sweep with which mold was formed.

A gate post built of concrete.



A covered concrete cistern.

Watering trough fitted with a portable cast-iron stove.

THE VERSATILITY OF CEMENT

should be filled with a good wet mixture of concrete. The inner side of the sheet-iron form should be well greased, so that it will come away easily from the cast and leave a nice smooth surface. It would be well to leave the molds or forms in place for three or four days after the concrete has been poured and then remove them, and wet down the cast every day for at least a week or more, in order to harden it thoroughly.

Good dry paths or walks connecting the various outbuildings around a farm are most convenient, especially in the spring time, when the soil is soft and muddy. These when properly made always look neat, and require no repairing. Weeds do not grow up in them, nor are they washed out with heavy rains as are dirt paths. One of the most essential features of a concrete path is the foundation. This should be made of some porous material, such as cinders. It should be at least six inches deep, and should be tamped down well and leveled off fairly smooth. On top of this should be placed at least three inches of concrete, made up of one part Portland cement to two parts of sand and from four to five parts of gravel or broken stone. Tamp this mixture until the water begins to show on top, and before it has started to dry or set a one-inch-thick top wearing surface should be laid on it. This top layer should be made of one part of cement with one and a half to two parts of good clean sand. It should be allowed to dry until it is fairly stiff, and then it should be smoothed off with a wooden float. Protect the surface from the sun, and keep it well wet down for two or three days, so as to harden it. If the walks are of considerable length, it would be well to put in expansion joints to prevent cracking.

From the above it will be seen that there is nothing very difficult or complicated about working in cement. The use of concrete fence posts is something that is becoming very general. This is due not only to the scarcity and high price of good straight-grained wood posts, but to the almost unlimited life of the concrete posts, their great strength and their neat and pleasing appearance. It is claimed that excellent concrete fence posts, about seven feet in length, can be made on the farm for from twenty to thirty cents apiece. This does not include labor cost, but represents only the cost of material for the concrete and the wire reinforcing for each post.

The Department of Agriculture at Washington, D. C., has just issued a bulletin on "How to Destroy the Rat." Rats devour grain, carry infectious diseases from house to house, and have become such a pest that the Department has made exhaustive investigations looking to their destruction. Obviously, the most direct procedure is to rob them of their nesting place, and with this object in view concrete floors are recommended for barns, poultry houses, corn cribs, and granaries. The experience of many farmers is, that

Filling a monolithic concrete silo.

grain mature enough to be placed in storage will not spoil on concrete floors, nor will corn mold in contact with them if there is good ventilation and the roof is tight.

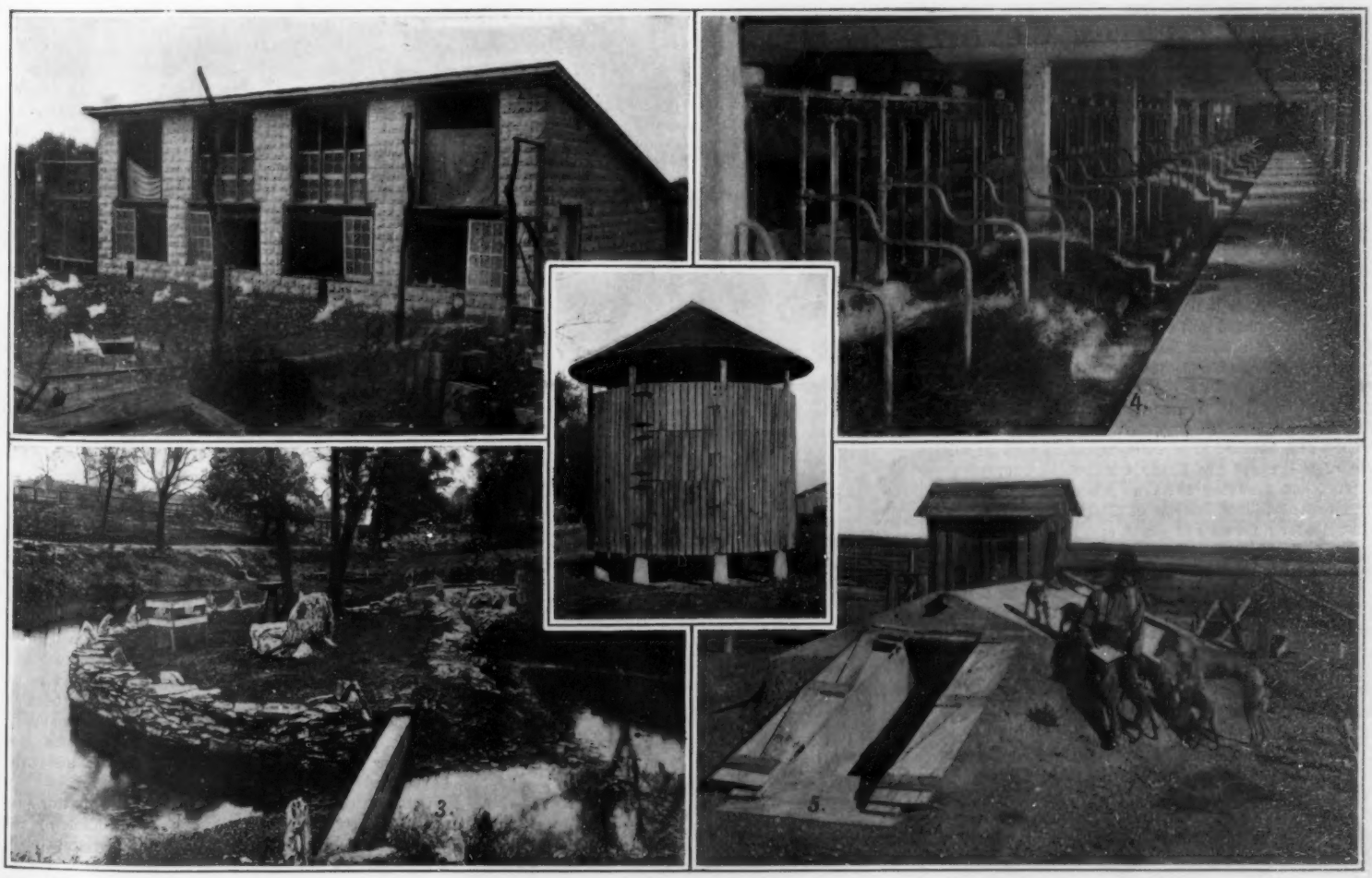
Another use for concrete is the building of silos or large tanks, in which fodder is placed and preserved in a green state for feeding stock when a natural green pasture is not available. Silos to-day are considered a necessity by the modern farmer. For it is claimed that a crop preserved by the use of a silo is increased about forty per cent in value over that of a crop harvested in the usual way. Concrete lends itself to the construction of silos better than any other material. It is one of the best non-conductors of heat and cold. On this account the temperature of the inside of the silo will be fairly uniform, regardless of the prevailing outside temperature. Concrete silos are fireproof and are not subject to rot or rust under the action of the acids formed by the slight fermentation in the silage, or by the alternate wetting and drying out which every silo receives. They are also vermin and rat proof. Concrete silos are generally made circular in form, and from two to three times their diameter in height. They are sometimes built of concrete blocks, but more often are made with monolithic or solid walls. A reinforced concrete silo can be built cheaper than one that is not reinforced, for the reason that thinner walls can be used, and thus the saving in concrete more than offsets the cost of the reinforcing steel required.

Being a poor conductor of heat and cold, as mentioned above, concrete has been used most successfully for the construction of greenhouses and ice houses. A greenhouse built of concrete not only eliminates constant repairs, which are required in a wooden structure, but it also saves fuel, as it retains heat and keeps out cold. The foundations and side walls can be made of solid concrete, as can also the posts and ridge poles; the latter, however, should be reinforced with steel. The tables and benches in the greenhouse should also be made of concrete, for by so doing the large expense and inconvenience of renewing, every few years, the old decayed wooden benches will be saved. There are various designs of greenhouse benches. Some are cast all in one piece, and others are made up in sections of concrete slabs. Whichever form is used, it will be well, in order to facilitate the drainage of the water from the table, to provide drainage holes in the bottom of the benches.

Concrete ice houses, owing to their durability, strength, and insulating qualities, have given considerable satisfaction. Experience has shown that the houses which give the greatest efficiency are those which are built with a double wall. These walls are generally about twelve inches thick and are made up of two three-inch walls placed six inches apart, tied together with galvanized iron rods or straps; thus making a six-inch wide continuous dead air space between the two walls, which adds greatly to the insulating efficiency of the buildings. The roof is also made hollow, to further the insulating qualities of the structure.

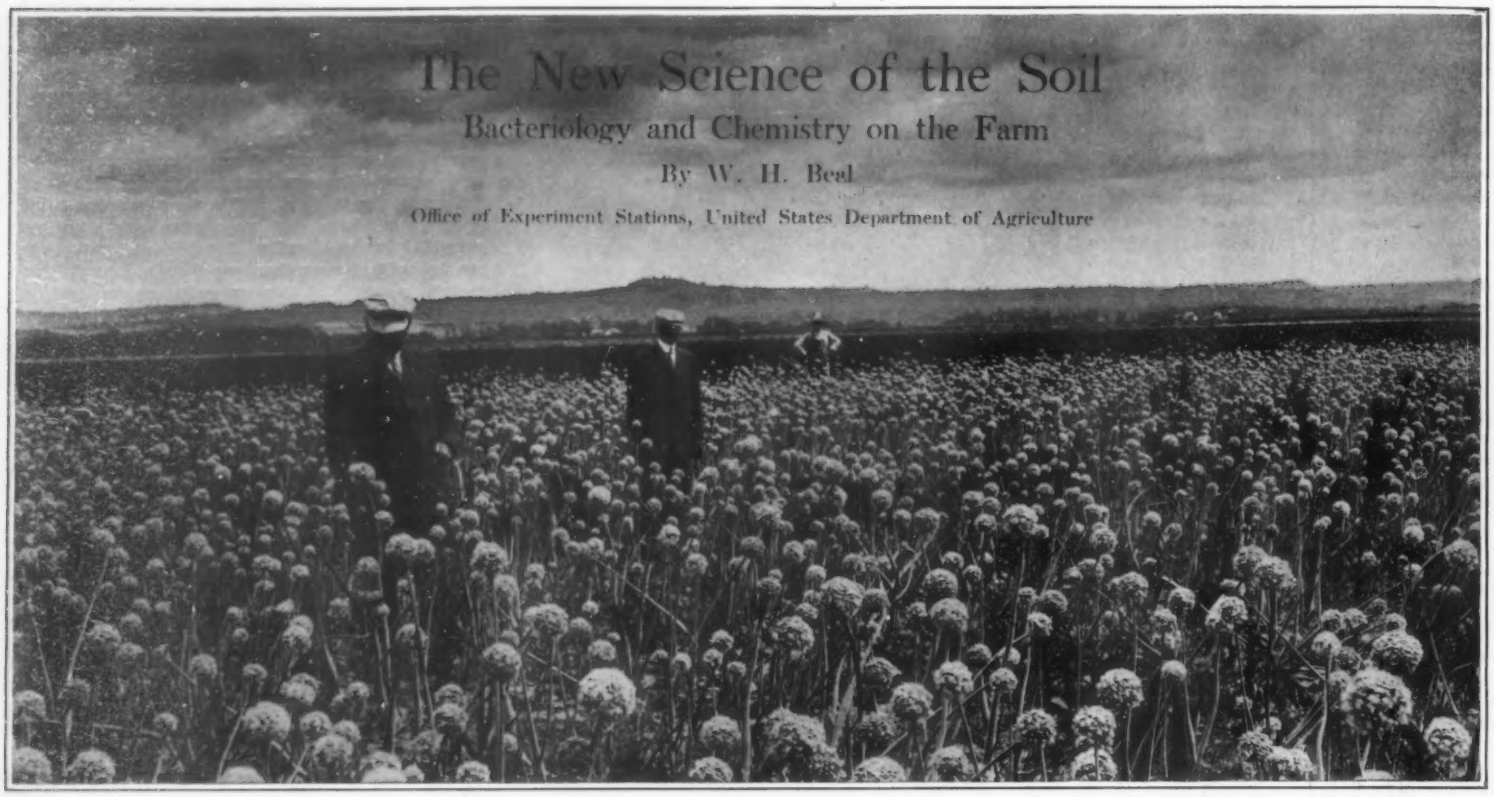
Root cellars and mushroom cellars are now commonly made of concrete. The root cellars are usually built half below and half above the level of the ground. The side walls, the partitions for the bins,

(*Continued on page 186.*)



1. Corn crib on a concrete foundation. 2. Chicken house of concrete blocks. 3. Dam of Portland cement. 4. Concrete floors make the stable sanitary. 5. A concrete cyclone cellar useful also as a fruit or a bee cellar.

SOME OF THE VARIED APPLICATIONS OF CEMENT TO AGRICULTURAL STRUCTURES



The New Science of the Soil

Bacteriology and Chemistry on the Farm

By W. H. Beal

Office of Experiment Stations, United States Department of Agriculture

SOIL fertility is our most important natural resource, for upon it depends the feeding of the nations of the earth and the perpetuation of the human race. It is for this reason that, as stated by Gifford Pinchot and forcefully maintained by Dr. Hopkins, of the Illinois Experiment Station, "the waste of the soil is among the most dangerous of all wastes now in progress in the United States." American farmers have been especially improvident of this resource in the past, and have impoverished their lands to such an extent that production has not kept pace with consumption, and an era of high prices for food has resulted.

The waste of the soil results not only from removal of fertility in the growth and sale of farm products without adequate return in form of manure and fertilizers (see the article "How the Scientific Farmer Fertilizes His Soil" in this issue) and from washing and leaching of the soil, but also, as so clearly shown by the work of the United States Bureau of Soils, from faulty adaptation of crops to soils.

Unsuccessful attempts are made to grow crops on soils not suited to them, or productiveness declines as a result of improper methods of culture, and the soils are said to be "exhausted," "tired," "sick," or "out of condition." These terms have long been used, but we are just beginning, in the light of scientific investigation, to understand what they mean.

Never before has there been such activity as at the present time in studying the properties, resources, and capabilities of soils and in disseminating knowledge of correct methods of soil culture. Never before have the resources of science been so drawn upon to aid the farmer in reaping a profit from the soil. As Secretary Wilson points out, the results are becoming evident in greater returns per acre from the soil.

As the first step in laying a foundation for the selection and utilization of soils, scientific men in all parts of the world are busily engaged in surveying, mapping, and studying the crop adaptations of soils.

The United States Bureau of Soils has carried on such work for a number of years, and up to June 30th, 1910, had surveyed, mapped, and studied the agricultural capabilities of 359,564 square miles or 230,120,960 acres of the tillable area of the United States. Typical areas and soils in all parts of the United States have thus been studied and reported upon. These reports are of especial value to the prospective purchaser of land and as an aid in the choice of crops to be grown or of soils suited to special crops. As a result of such work, the United States Department of Agriculture and the State experiment stations are prepared to give specific advice regarding the character and capabilities of soils in almost every region of the United States.

Such surveys show the present condition and capabilities of soils, but scientific investigation of soils has gone much further than this. It has dealt with the fundamental principles of soil fertility, the causes of deterioration of soils, and methods of restoring their fertility, and in this work the highest skill of the chemist, the physicist, and the bacteriologist has been enlisted, for it is now understood as never before that the soil is not an inert medium for the support of plants, but a complex organism, in which the most varied chemical, physical, and bacteriological forces come into active operation. In order to be productive soils must not only contain the necessary food for plants, but must have suitable conditions of texture, moisture, and temperature, and furnish a favorable medium for the growth of beneficial micro-organisms (bacteria).

In the scientific study of the soil, certain well-defined groups of methods of investigation have been employed. These include (1) chemical and mechanical or physical analysis; (2) pot experiments, in which plants are grown on small amounts of soil under comparatively well-controlled conditions of moisture, temperature, etc., and the behavior of the plant noted as an index of the character of the soil; and (3) field or plot experiments, in which crops are grown on the soil under natural field conditions. Each of these methods has its advantages and limitations. Chemical analysis shows the proportion of plant food present in the soil and to a certain extent the availability of the different constituents. It shows whether a given constituent is deficient or present in excess and whether harmful substances are present. Chemical analysis is therefore indispensable in any thorough study of the present condition and probable durability of a soil, but is not alone sufficient to show productiveness or fertilizer needs.

Fig. 1.—Method of determining the amount of water required by crops.

Chemical analysis has shown that the soil must contain sufficient amounts of about fourteen elements in order to support normal plant growth, and that while most of these are usually present in abundance, some, more particularly nitrogen, phosphoric acid, and potash, and sometimes lime, are especially likely to become deficient in the course of ordinary farming, and must be restored by the use of fertilizers. From analyses of a large number of soils from different parts of the United States, Hilgard shows that soils from regions of normal rainfall contain on the average 0.12 per cent of nitrogen, 0.11 per cent of phosphoric acid, 0.22 per cent of potash, and 0.11 per cent of lime, while those from regions of scanty rainfall contain 0.10 per cent of nitrogen, 0.12 per cent of phosphoric acid, 0.73 per cent of potash, and 1.36 per cent of lime. Calculated to pounds per acre, and assuming that a cubic foot of average soil weighs 80 pounds and an acre to a depth of one foot weighs 3,484,800 pounds, an acre-foot of soil contains the following amounts of the principal elements of plant food: In humid regions, nitrogen, 4,251 pounds; phosphoric acid, 3,938 pounds; potash, 7,327 pounds; lime, 3,764 pounds. In arid regions, nitrogen, 3,520 pounds; phosphoric acid, 4,077 pounds; potash, 25,404 pounds, and lime, 47,463 pounds. The arid soils are thus shown to be much richer in all of the constituents except nitrogen, than the humid soils, and this explains the well-known fertility of the soils of arid regions. Soils are, however, so variable in chemical composition that it is difficult, and in many cases impossible, to classify them as regards fertility on this basis. Nevertheless, it is desirable to have an approximate standard for interpreting the results of chemical analysis of a soil. Hilgard states that potash may vary from 0.8 to 0.5 per cent in heavy clay uplands, from 0.45 to 0.3 per cent in lighter loams, and may fall below 0.3 per cent in sandy loams and below 0.1 per cent in sandy loams of great depth, with good productiveness and durability. One-fourth of one per cent (0.25) is considered generally adequate. Lime varies from 0.1 per cent in high sandy soils to 0.25 per cent in clay loam, to 0.3 per cent in heavy clay soils, and may rise to 1 to 2 per cent with advantage. One-tenth per cent of phosphoric acid, when accompanied by a fair supply of lime, is usually sufficient for productiveness. One-tenth per cent of nitrogen is also considered adequate as a rule.

Soils are composed essentially of mineral matter and organic matter. The organic matter is commonly referred to as humus. Humus represents organic matter in various stages of decay. The average proportion of humus in arid soils, is according to Hilgard, 0.75 per cent, in humid soils 2.7 per cent, but obviously the proportion of this constituent of soil varies widely. Humus is a most important constituent of

soils, for upon it depends to a large extent the nitrogen supply of the soil, the availability of the mineral constituents (phosphoric acid and potash), the food supply of beneficial soil bacteria, and the physical condition of the soil. Snyder found that Minnesota soils, which had been subjected to continuous grain cropping without rotation or manuring for ten to fifteen years, had lost a large part of their humus and nitrogen, and in consequence, had become greatly reduced in fertility.

Notwithstanding the recognized importance of this constituent of soils, little has actually been known until quite recently of its chemical composition and properties. Within the past year, however, Schreiner and his colleagues of the United States Bureau of Soils have reported the isolation from the organic matter of the soil of no less than twenty complex organic compounds, some of which appear to be toxic to plants and may explain the so-called "sick" condition of certain soils.

Chemists and physicists have also been very active recently in studying the soil solution. This solution is the sap or life blood of the soil and the carrier of food to the plant. The ultimate yield of plants depends upon the composition and concentration of the soil solution and the rate at which it supplies the plant with food at different stages of growth. If the solution becomes poor in plant food the plant pines and dwindles. If on the other hand it becomes too rich in plant food or surcharged with deleterious substances, as in the case of alkali soils, the plant will also suffer. A moderately rich soil solution, the concentration of which is steadily maintained, is that which is most conducive to normal, vigorous plant growth. If soils are not naturally capable of maintaining such a solution, they must be made so by judicious use of manures and fertilizers.

Soils become unproductive and are said to be "exhausted" or "worn out" when the fertility has been reduced to such an extent by washing, leaching, cropping, and improper methods of culture that the soil solution no longer renews itself sufficiently fast to supply the demands of vigorous crop growth. There is, however, no such thing as exhausted or worn-out soils in the true sense. Soils become impoverished so that they are no longer profitably productive, but never exhausted to such an extent that they may not be restored to productiveness by proper methods of tillage, rotation of crops, and manuring. The fact is that the highest level of production is often maintained on soils which have been longest under cultivation.

As already indicated, soils are sometimes rendered unproductive by excess, as well as by deficiency, of soluble constituents, as for example, in the case of alkali soils occurring in regions of deficient rainfall, which are made barren by an excess of the same salts that are found in greater or less amount in all soils and give them their fertile qualities when present in proper proportions.

Occasionally unproductiveness is due to excess of one constituent over another. For example, Loew and others attribute the unproductiveness of certain soils to an excess of magnesia over lime, and teach that a more or less definite ratio must be maintained between these two constituents in order to secure normal growth, i. e., soils which show an excess of magnesia over lime must be limed until the proper ratio is restored.

W. P. Kelley and F. B. Guthrie have shown that certain Hawaiian and Australian soils are rendered unproductive by the presence of excessive amounts of magnesia.

Soils probably more frequently become unproductive as a result of unfavorable physical conditions than from any other cause. In such cases the soils are frequently referred to as "out of condition." The soil investigator endeavors to determine the physical condition of soils by means of mechanical analysis, which separates and measures the different sized particles, sand, silt, clay, etc., and by studies of the texture and structure of the soils with reference to their behavior toward heat, gases, water, and solutions. Probably the most important single determining factor in the productiveness of soils is water, for plants cannot grow without a sufficient supply of water in the soil at all stages of development. Water is not only an important constituent of plant tissue, but as already indicated it is the solvent and carrier of food in the soil and in the plant. For each pound of dry matter produced by the plant the soil must supply 250 to 500 pounds of water, a large proportion of which, however, passes into the air by transpiration through the leaves, and from the surface of the soil by evaporation.

Soils vary widely in their capacity to absorb and retain water, and it is upon this that their adaptation to crops largely depends. Coarse sands have little retentive power for water, while clay soils absorb and retain a large amount. Organic matter (humus) increases the absorbent power of soils for water. Plants, however, will utilize a larger proportion of the water in sandy soils than in clay or humus soils. Ordinary crop plants will not grow normally in saturated (water-logged) soils, the most favorable amount of water being from 40 to 75 per cent of that which the soil can hold when completely saturated. A wet soil is cold and therefore unfavorable to plant growth.

Many careful studies have been made of the exact amounts of water required for the normal growth of various crops on different kinds of soils. Fig. 1 illustrates apparatus and methods used with very satisfactory results for this purpose by Prof. Samuel Fortier in irrigation investigations for the United States Department of Agriculture. By applying different weighed amounts of water to a series of pots sunk to their tops in the soil and withdrawing and weighing them from time to time in the manner indicated in the figure, data are obtained as to the amounts of water giving the best results in crop yields and of that lost by evaporation.

It has been found that the amount of water required by plants is controlled to a large extent by the soluble plant food in the soil, i. e., plants require less water on soils whose solutions are abundantly and constantly supplied with plant food than on poor soils whose solutions are deficient in plant food—a fact of great importance to regions dependent upon irrigation or subject to droughts. To utilize a scanty supply of moisture to the best advantage the farmer must keep his soil rich.

However, the soil is not a dead mass controlled entirely by chemical and physical laws, but, as the great Berthelot declared, it is a living thing. It is the scene of the activities of living organisms (bacteria) which have a most important influence upon its fertility. In the soil, as in the animal body, beneficial and harmful organisms are constantly struggling for supremacy. When the latter gain the mastery, fertility declines and the soil becomes sick; when the former prevail, the soil is healthy and its fertility is enhanced. There are organisms in the soil which increase the store of nitrogen by fixing the free nitrogen

(Continued on page 186.)

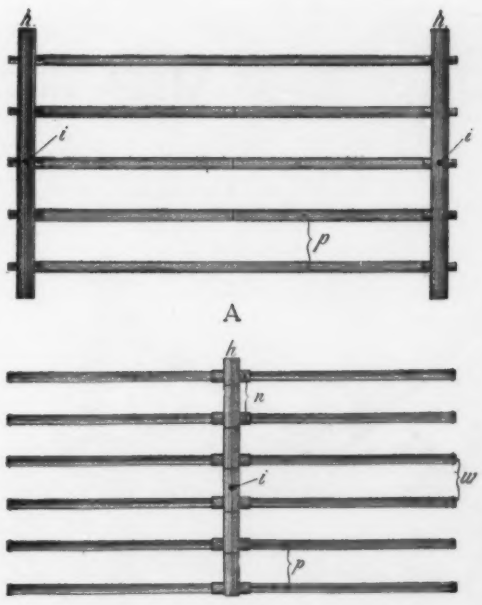


Fig. 2.—Types of steam sterilizing apparatus for greenhouse soil. Inlets for steam at i.

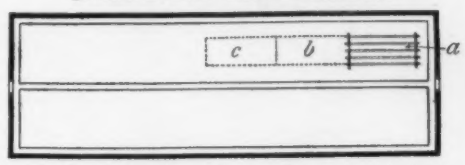


Fig. 3.—Plan of greenhouse, showing method of sterilization with steam.

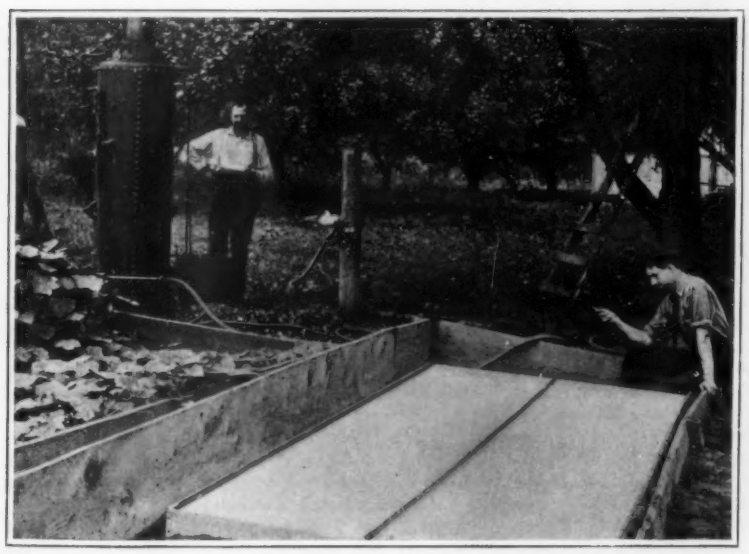


Fig. 4.—Soil sterilizers for tobacco plant beds. Part of an elaborate equipment with which government experts are experimenting for the benefit of tobacco growers.

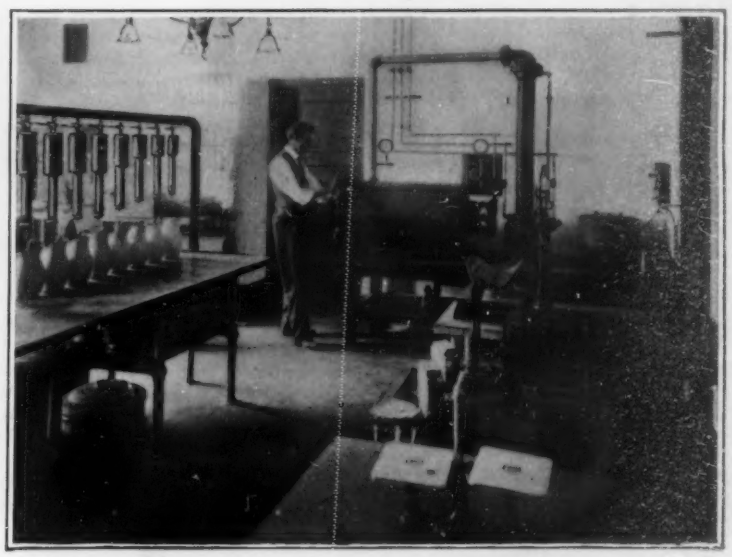


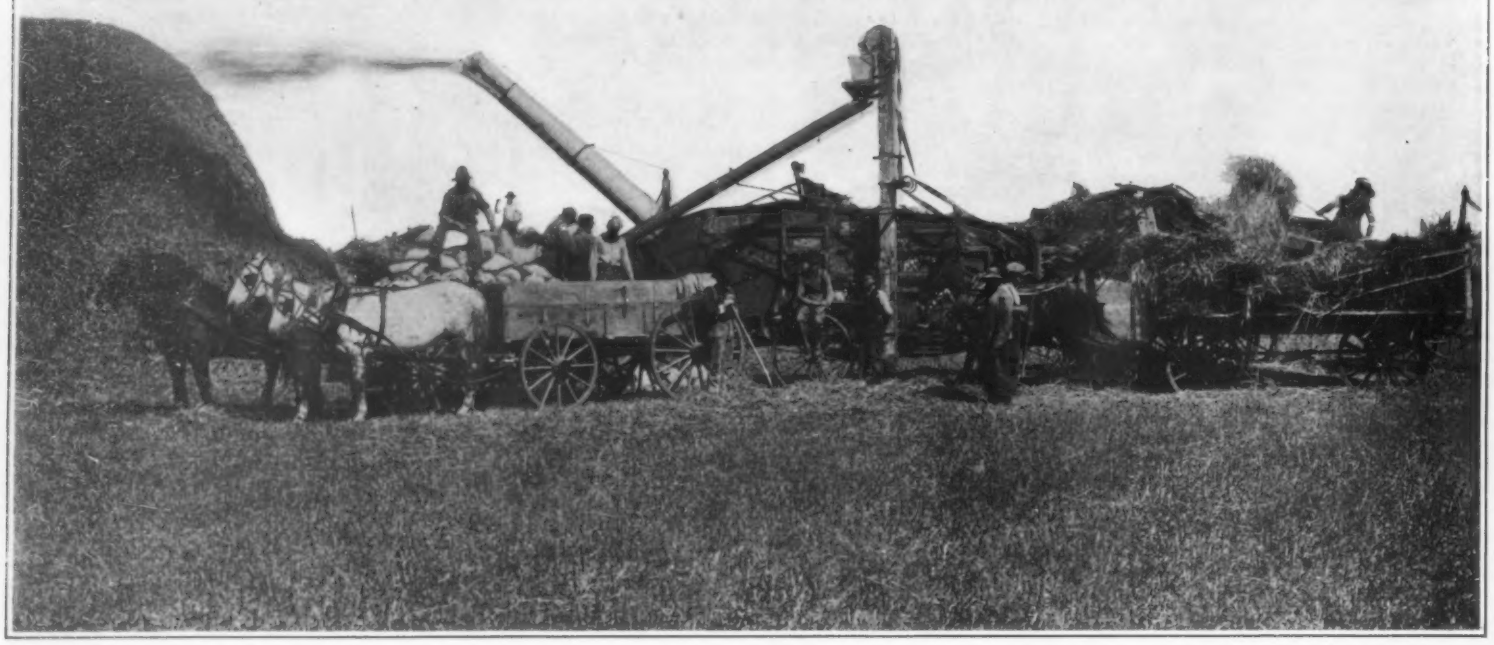
Fig. 5.—Various special forms of apparatus employed in soil investigations in laboratory of the United States Bureau of Soils.

Fig. 6.—Apparatus used for extracting organic matter from soils in the laboratory of the United States Bureau of Soils.

New Methods and New Machines for the Farm

What the Inventor has done for Agriculture

By M. R. D. Owings



IN all the history of empire building there is no chapter to compare with that which tells the story of the development of the great West from a vast stretch of prairie, desert and primeval forest into the richest and most extensive agricultural empire in the world. The rapidity and completeness with which this transformation has been effected are chiefly due to the invention of agricultural machinery of wonderful precision and capacity. The following article, written by a well-known official in our largest agricultural implement establishment, explains how the mechanical engineer has at once simplified the work and increased the output of the farm.—EDITOR.]

Have you ever made the trip from New York to Frisco? Did you ever get a whiff of the Western ozone, and did you ever stand at the grim out-posts of our Western progress and survey the ever widening fields growing ripe with the harvest? Unless you have journeyed across the great continent that lies between the Atlantic and Pacific oceans it will be difficult for you to understand what a wealth of agricultural resources we have, or to what degree they have been developed. In this fair land of ours, we now have approximately 700,000,000 acres of land under cultivation, from which in 1910 we produced $8,926,000,000 worth of crops.

The story of this stupendous development is largely a story of the development of agricultural machinery, and it is the purpose of the present article to show what great results have been accomplished by the introduction of a few notable machines among the many that our great agricultural machinery establishments have placed at the disposal of the farmer.

TRACTION ENGINES ON THE FARM.

Of all the progressive elements which go to make up our peculiar American civilization, perhaps the American farmers are the most conservative. In rare instances do they jump at untried things, but also in equally rare instances do they let an invention of proved value get by them. In the good old days of the early reapers and binders, our grandfathers had a merry time watching the contest of the inventors and manufacturers of these machines in their efforts to establish their worth. They scoffed at first—who would not?—but when once convinced they accepted them as their own. And the $9,000,000,000 crop of 1910 is a testimony to their wisdom. Newer and later improvements in this field have run the same gauntlet. The cream separator was rejected until the big dairies came to its rescue. Manure spreaders were received with doubt until the government tests substantiated their value. And now it is the powerful gasoline tractors which are in the limelight. At every big fair and concourse of agriculturists these machines are made to "show off" at plowing and hauling and threshing like champion strong men. Sometimes a dozen or more are in the same field at one time, chug-chugging at each other in a very human way. That this chug-chug is going shortly to revolutionize the heavy horse work of farming seems certain, as some of the records of these engines are nearly as miraculous for their speed and cheapness as compared with the present methods as the old-time reapers were compared with the cradle and sickle.

American farmers are solving the labor problem. With the opening up of the huge wheat lands in the West, the new settlers have laid violent hands on the labor-saving traction engines used by their neighbors and are calling them their own. At first the powerful noisy steam outfits held sway, but as they were soon found to be suitable only for the very large farms they are fast giving way to the lighter, cheaper, and handier gasoline tractor. These tractors are so inexpensive in their maintenance and can be used for so many different purposes, that they are doing more than any other single factor in straightening out the labor difficulties of the Western and Northwestern farmers. These aggressive, business-like pioneers have taken the reins in their own hands and where they could not get assistance in their time of need from human beings they have turned triumphantly to the greater power of machinery. It is no uncommon thing for a farmer with only a gasoline tractor to tackle single-handed a ten-acre field, plow it, harrow it, and roll it all in one day, at a cost of from 40 to 50 cents per acre. Under the old sway, with men and horses, it is estimated that it would have taken ten men and twenty horses to do the same work in the same time and the cost of the plowing alone would have been $1.25 per acre.

At harvest time this same farmer takes the same engine and draws two or more harvesting machines, thus eliminating the expensive man and horse hire of the old-fashioned "three horses and a man" outfit of a few years ago.

Later in the season, when it comes to threshing, he can use the tractor to operate a threshing machine. He thus frees himself entirely from the annoyance of waiting for what is known as "custom threshers."

Finally he attaches his tractor to a number of wagons and hauls his produce to the nearest elevator or railway station. One tractor alone, of twenty horse-power, has been known to haul fifteen tons for two hours, using only five gallons of gasoline. When he returns from the elevator, after having delivered his last load, his season's work is done. He started out with his engine and he finishes with his engine. Throughout it all his tractor needed the attendance of only one man. There was no delay in getting up steam—no hauling of fuel or water—no danger of fire—no cost except when in actual operation.

Between seasons his engine needs no rest. It saws wood, pumps his water, operates his husker and shredder, runs his feed grinder, and does other off jobs which on the more primitive farms make hard the lot of the man who tills the soil.

That these engines have come to stay needs no proving. They have invaded Europe, as did the American harvesters of a quarter of a century ago. What their future is to be in Europe is still problematical; but in the Argentine, in the United States, and in Canada, they are filling a national necessity. Like the reaping machine and harvesters, they have come to the aid of the farmers who were wont to let half of their land go untilled because they could not get men to work for them. They have come as an eleventh hour succor to the farmer who, with tears in his eyes, watched his ripened wheatfields go to waste because there were no hands to harvest them.

Given a few more years of education and experience, and the constant chug-chug of the gasoline tractor will have drowned the cry of the West for men to save the crops. It will neutralize the hejira of young men drifting to the cities of the East, and will add another step toward increasing the production and lessening the price of the food supply of the world.

THE CORN CROP.

The United States produces seventy-eight per cent of the world's corn crop, more than 100,000,000 acres being devoted to the production of this cereal.

Until a few years ago it was commonly supposed there was very little value in cornstalks, and no one dreamed of the neglected fortunes that lay concealed in the snow covered cornfields.

Most of us have vivid recollections of our boyhood days, and the hard work which attended the gathering in of the corn crop. It meant long hours, hard work, and bruised hands. Huskers' gloves and husking pegs wore out just when they ought not, and tender hands received many scratches that sometimes developed into serious wounds. Corn harvest meant a tiresome, trying time. Those days have passed along with a good many other days of drudgery that used to characterize life on the farm. Of course, there is still considerable work on a large farm, but it can be materially lightened by the use of modern machines. There is no reason why the farmer, who admittedly belongs to the most prosperous class in the country, should deny himself anything which will make his life easier and add to the profit he can secure from his acres.

The remarkable results that have been obtained in feed-ensilage are due to the fact that the juices of the growing corn are preserved in the silo in soluble form. If corn is harvested at the right time, before it gets too ripe, the change from the soluble to the insoluble form is arrested, and the fodder cures into nutritious feed which, when shredded, is superior to hay; while the same fodder if allowed to stand a week longer would lose much of its feeding value. Every farmer has observed in cutting timothy or clover that if the crop is taken at just the right time, it makes fine hay, but if allowed to stand too long it becomes dry and woody and does not make good feed. If allowed to stand until it has become too ripe the rich sap turns into woody indi-

gestible fiber and the fodder becomes hard, tough, and unpalatable to the stock. When green corn is cut and thrown out on the grass, cattle will eat it, stalks and all, in preference to the grass, and fatten on it. Overripe fodder, however, is not much better than straw.

When corn is cut by hand, a man can not cover more than a few acres at the right cutting season. With the corn binder it is possible to save it all with the same care that a practical farmer gives to his timothy or clover. The ears do not shrink when the corn is cut and shocked at this critical time, as they cure with fodder in the shock the same as though left standing, and the yield of the corn to the acre will be as large as though it had stood uncut until the ears had fully ripened. The great value of the corn binder is due to the fact that it enables the farmer to cut his corn without hand labor, and at the same time it gives him a crop of fodder which is equal in feeding value and tonnage to a crop of hay from the same land. It gives two crops instead of one from the cornfield, and the second crop, the fodder, is the most profitable of the two because it costs nothing to grow it.

The corn binder is the great triumph of the opening years of the 20th century. It gives the farmer a successful machine with which to conquer on the last great battlefield of hand labor on the farm. It completes the chain of inventions which enable the farmer to ride on a comfortable spring seat in all his work from the first furrow of spring to the last corn row in the fall. It is an achievement which has tried the mettle of hundreds of inventors, for corn is a stubborn crop which seems to take a delight in baffling the inventors who seek to build corn-harvesting machines. Not many years ago it was a common saying among the men who were experimenting with corn binders, that anyone could build a machine to cut nice "Sunday school corn," where the stalks all stood up straight in the rows, but that the real test where inventors failed was in trying to handle corn so that the crop might be harvested under all the conditions in which it is found at cutting time. This was the test in which the corn binder proved the master.

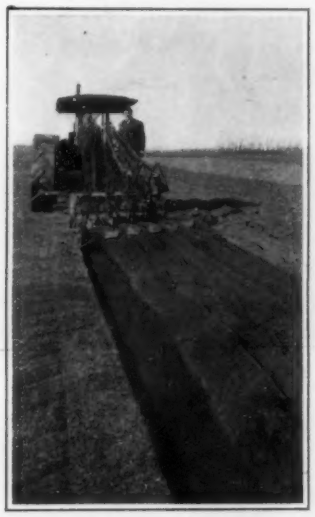
Standing up to its work, the machine moves forward straddling the row, the long dividers which project forward on each side of the row pick up the down stalks, and the gathering chains lift them up into a vertical position. The corn is not carried back through the machine, strictly speaking, for the machine moves forward and gathers the corn into bundles as it cuts much as a man might walk forward a-straddle of the row gathering up the corn in a bundle in his arms and cutting it as he went, with knives attached to his feet. In this manner the corn is handled gently, yet firmly, and is bound into compact, square butted bundles which stand up in solid shocks. This is the triumph of the corn binder; it will harvest the crop in any and all conditions in which it is found in the field—big corn, little corn, down corn, lodged corn, or any other kind of corn that grows in rows.

It is about forty years since inventors began to dream of a corn-husking machine, but it is only within the last fifteen years that practical machines have been available for the farmer. So long as the husking of the corn was the only object sought, there was no real demand for these machines, because the farmer could not save enough labor to warrant their use. Since the discovery of corn fodder, and the equipment of these machines with shredder heads to shred the fodder, the demand has grown rapidly. The strains to which a husker and shredder are subjected, especially from handling heavy corn, are very severe and the strongest and most scientific construction is required to make a desirable machine. It was not until firms having large capital had taken hold of the problem and had brought all their technical skill and experience to bear that it was possible for the farmers to obtain a moderate priced machine that would give them entire satisfaction. The owner of a large farm, or three or four owners of adjoining farms, can club together and buy a machine which they can run themselves in the winter, thus employing their time profitably when no other farm work can be done. The clubbing plan has been very generally followed by farmers, and has enabled farmers to save their fodder crop and turn it into beef or butter, thus adding considerably to the incomes from their farms.

DITCHING AND EXCAVATING.

Another operation in which machines are called to the aid of the farmer is excavating and trench digging. The performances of some of the mechanical excavators on the market are very wonderful. Not only do they far surpass hand labor in speed and economy, but they will successfully cope with soil which is practically unmanageable by hand. Any

The corn binder cuts the corn and binds it into square, butted bundles which stand up in solid shocks.



Traction plowing. Note the straight, clean furrows.

Twenty-horse-power traction engine hauling two wagons loaded with cotton weighing 15,000 pounds.

Plowing and seeding at one operation by traction engine power. A typical scene in the West.

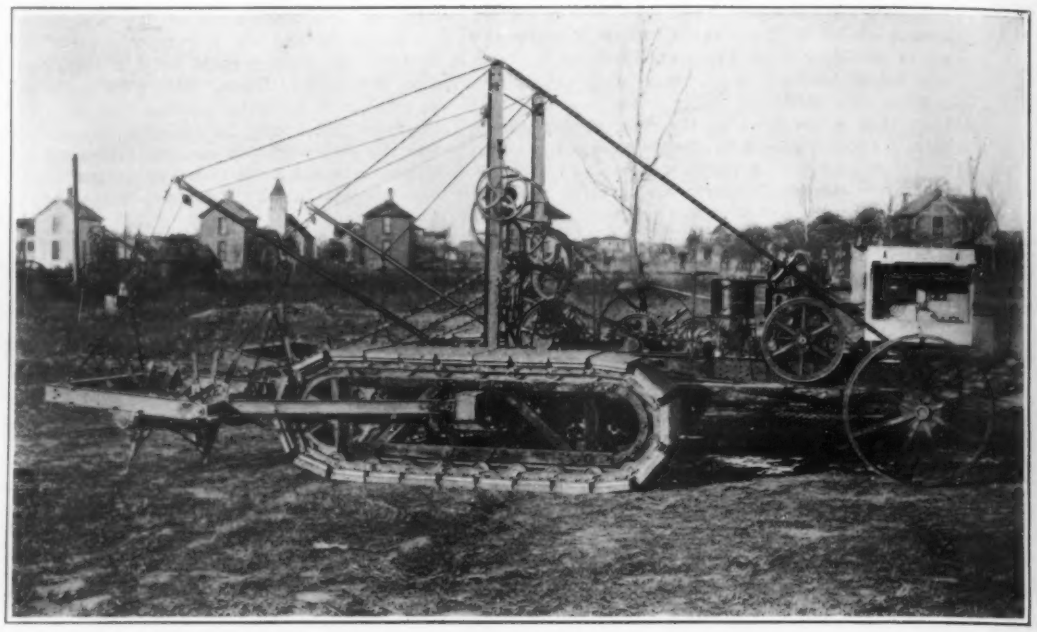
This manure-spreader in five minutes will scatter a full load of manure from the rear of the wagon.

Header binder (teams pushing machine) cutting a 12-foot swath.

The husker and shredder—one of the greatest labor-saving machines ever invented.

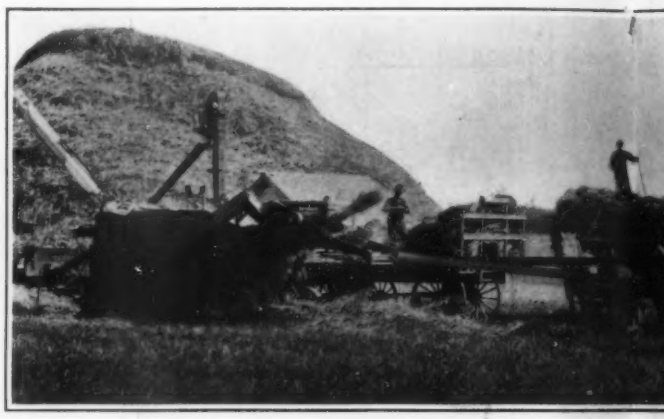
MECHANICAL HELPMEETS OF THE FARMER.

A disk plow at work leaving a concave furrow.



A traction ditcher, equipped with "gumbo" skeleton buckets for work in very wet, sticky soil.

Modern methods of threshing in the far West.



A 20-horse-power traction engine driving a threshing ma

A combined harvester at work on a farm near Willows, California.

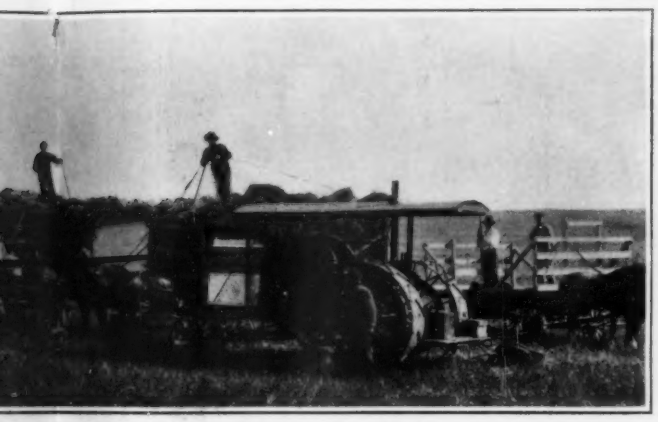
A traction engine hauling a gang of reaper

Clearing off the top soil and stubble with the aid of a traction engine.

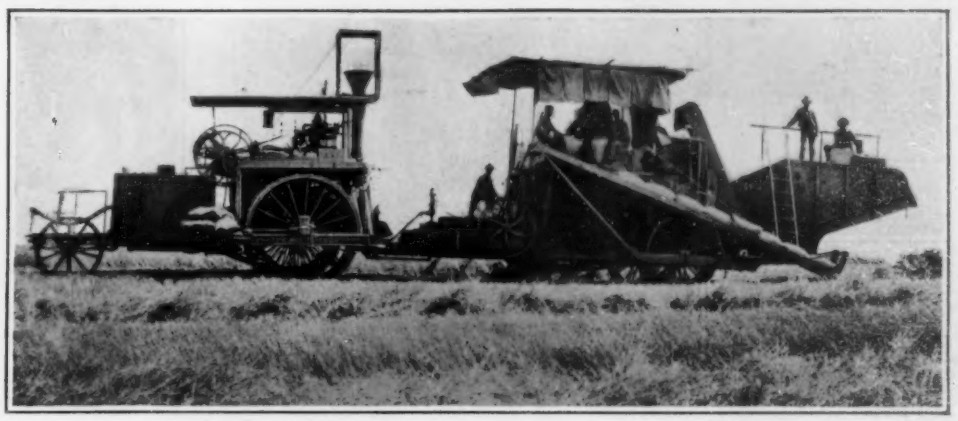
A rear view of a traction ditcher, showing cutting wheel.

A reaper and binder working in an awkward position on a hillside.

A drill used to plant seed.

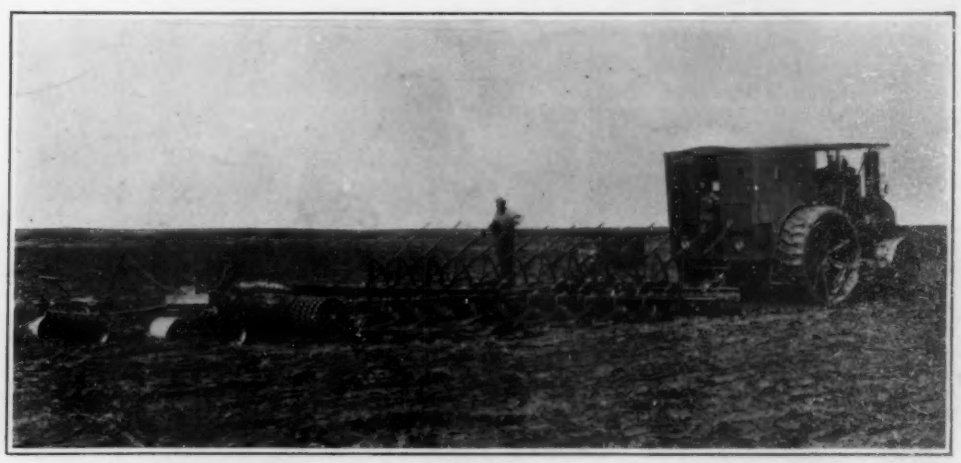


hreshing machine on a farm at Bradwardine, Manitoba.

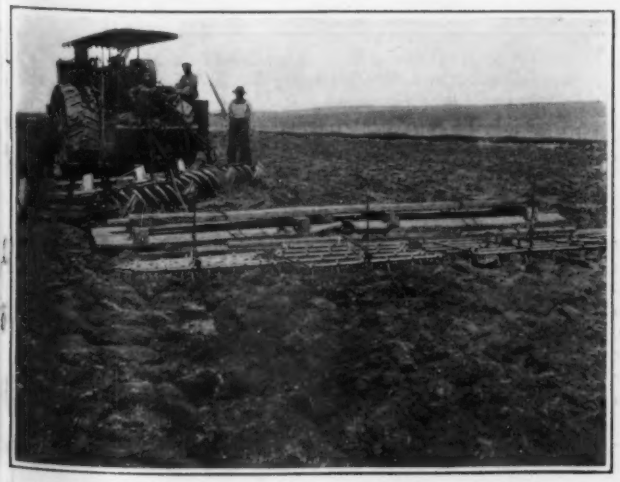


A threshing outfit, hauled by a traction engine, starting out for the field.

ng of reapers and binders in Saskatchewan.



This outfit broke 2,600 acres, packed and disked it, at an average cost of $1.22 per acre.



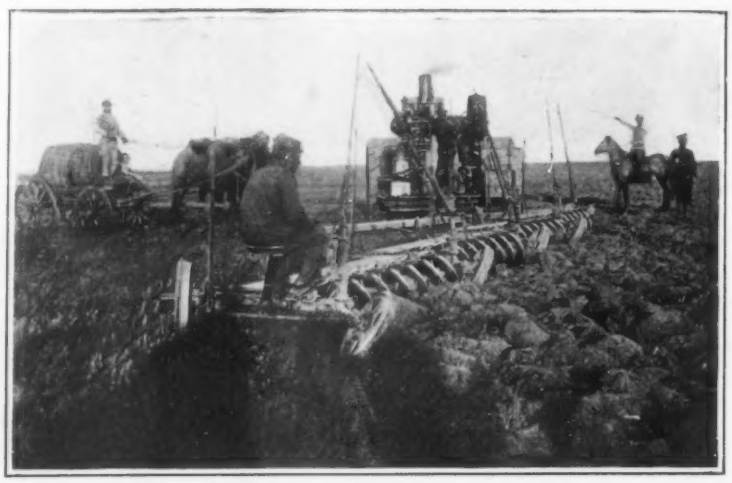
A steam plow outfit employed in the Judith Basin, Montana.

Crushing and sacking barley near Willows, California.

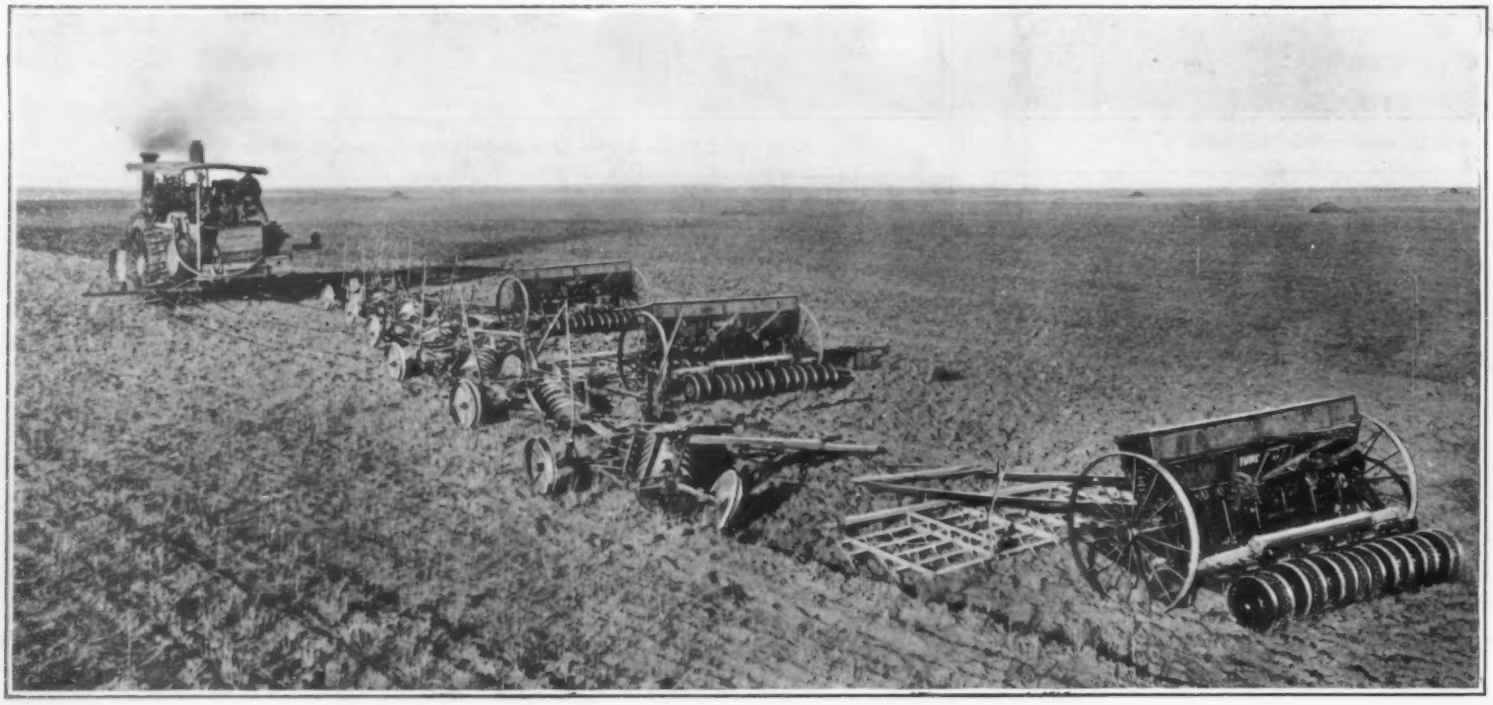
Portable gasoline engine driving elevator which loads corn into the silo.

Traction engine drawing gang of plows and a pulverizer.

This machine loads the hay onto the wagon behind which it is being drawn.



Gang of disk plows drawn by a traction engine.



Traction engine hauling a battery of farm implements.

SOME OF THE ENGINES THAT MAKE MONEY FOR THE FARMER.

ground that can be loosened with a pick can be excavated with a mechanical excavator.

The machine will cut through hardpan or shale or frozen ground, in which profitable picking by hand is impossible. Thus, for example, in street excavating, old macadam roadways are cut through without the least trouble. Such a machine will make its way through a log of timber buried in the ground. If, however, the cutters strike a huge boulder, too large in diameter to be taken out of the trench, the wheel of cutting buckets must be raised out of the trench until the obstruction is passed, or the boulder must be loosened by hand, picked up with a chain and raised by power, for the machine cannot, of course, cut through boulders. There is, however, no danger of breaking the machine when it strikes a boulder, as the cutting wheel is mounted between two beams that can be raised when a severe obstruction is encountered, permitting the cutting teeth to pass through them. At the worst, if the cutting teeth catch in the obstruction, all that would break would be a cutter bolt or a chain link, which can be quickly replaced. The machine will excavate any boulder that is not too large to enter the buckets.

MAKING THE ACRES MORE FERTILE.

The manure spreader is another addition to the new equipment of the farm. The increase in crop values from machine spreading is very large. Fresh machine-spread manure has caused the soil covered to show a gain of 32.6 bushels of corn per acre. This, say at 50 cents per bushel, amounts to $16.30; twenty acres would total $326, and every farmer every year can put this down to profit or loss. It all depends on which way he is going—the old way or the new.

The greatest savings have been left to the last—the savings of time and human strength, and the boys on the farm. It takes a pretty strong man to spread a load of manure in thirty minutes; it is a pretty poor manure spreader that can not do the job in five minutes. Time is money to all but the extravagant.

It has been said, and with much truth, or so it sometimes seems, that "everything is held dear but human life." This seems, or has seemed, doubly true of life on the farm. More lives have been actually worn out on the farms of the country than in all other lines of endeavor combined. The farmers have not been killed outright, as on railroads and in mines, but they have been worn and bent, and sapped of energy. Happily this condition is passing. Improved machines and a greater knowledge of the ways of doing things are working the change.

Among the machines which are contributing to the ease and profit and happiness of the farmer, none is more conspicuous than the manure spreader. It is taking the strain from the back, the blisters from the hands, and the general disagreeableness from the whole job of spreading, and in their stead is giving the young man on the farm a reasonable willingness to stay there. Health, strength, and contentment are the assets of life. A machine that conserves these is the next thing to the Fountain of Youth, which Ponce de Leon looked for but never found.

The Farmer and the Weather Bureau

The Latest Chapter in the Story of Practical Meteorology in America in its Applications to Agriculture and Horticulture

By Charles Fitzhugh Talman, Librarian, U. S. Weather Bureau

THE ARMY SPIRIT.

THE earlier chapters of this story have been written, not once, but a hundred times; so often, in fact, that I am going to dispense with the customary "synopsis of previous chapters" of the writers of serials, and plunge at once into my narrative.

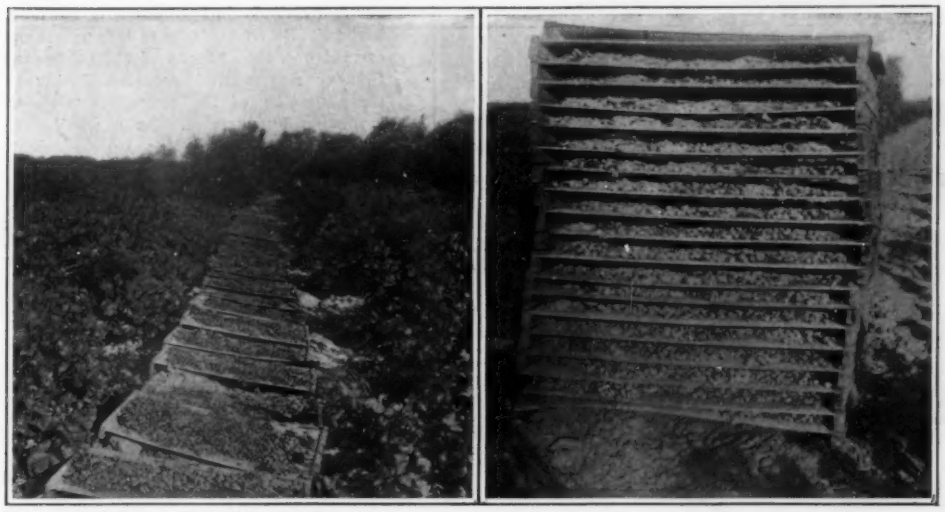
The national weather service, once a branch of the army, was separated therefrom for several reasons, only one of which is pertinent to the present story. The act of Congress that established the Weather Bureau as a civil branch of the government provided, in so many words, that it should "be hereafter specially developed and extended *in the interests of agriculture*." The removal of the Weather Bureau, in 1891, from the War Department to the Department of Agriculture—from Mars to Ceres—was possibly one of the most conspicuous examples in history of the process described by an apostle of peace who antedated Nobel prizes: "They shall beat their swords into plowshares, and their spears into pruning-hooks."

Taking the "plowshare" to symbolize agriculture and the "pruning-hook" horticulture, we have in these words an epitome of the paramount duties that devolved, in the year 1891, upon the Weather Bureau of the United States Department of Agriculture.

Passing over the twenty years that have elapsed since the event invariably referred to, among the initiates of the service, as "the transfer," let us see how well the Bureau is fulfilling to-day the duties especially enjoined upon it by Congress.

Fig. 1.—One of the army of six hundred in action.

The Weather Bureau observer at Grand Junction, Col., rushing a frost warning to the fruit growers of the Grand Valley. With only a messenger boy to aid him, this soldier of the government's little meteorological army is detailed to guard one of the fairest fruit-growing regions of the West against the incursions of Jack Frost.



Photos by W. E. Bonnett, Fresno, Cal.

Fig. 2.—An episode in the raisin industry in California—before and after the Weather Bureau has predicted "showers."

Imagine each of these pictures multiplied many thousand times. California produces over 100,000,000 pounds of raisins every summer. When rain is predicted the community turns out *en masse* to stack the trays, as shown in the right-hand figure.

These men are, for the most part, on outpost duty; one here, two there, rarely three or more sharing the responsibilities of a single post. They are, all in all, a body of earnest and hard-working men, taking themselves and their work very seriously and little concerned with the hasty and ephemeral judgments of outsiders as to their value to the community. They are not, in the great majority of cases, *savants*, and do not pretend to be. Some of them are men of mediocre education, judged by academic standards. They are practical men; not in the sense of scorning knowledge in the abstract, but in the capacity for applying all the knowledge they have, and for entering into a sympathetic understanding of the everyday needs of humanity. It is too often the case that when the public craves bread, science offers it a stone—possibly a precious stone, from the point of view of the intellectual gem-collector, but one that is both heavy and indigestible as a substitute for the staff of life. It is conceivable that if the field force of the Weather Bureau consisted entirely of Ph.D.'s, the net result of their utilitarian labors might be less valuable than it is.

The unwritten history of the Bureau contains innumerable instances in which the soldiers of this little army have displayed rare courage and fidelity under trying circumstances, and very few in which they have been found wanting in these qualities.

Relieved of the incongruities that hampered its progress under military administration, the Bureau has nevertheless preserved military traditions. Its discipline is still rigorous; its *esprit de corps* admirable. Habits of promptitude and obedience formed by military service clung to the men who, in 1891, were made civilians by Congressional enactment, and have been handed on to their juniors. It is no disparagement of the other scientific and humanitarian branches of the government to say that, in comparison with them, the Weather Bureau is especially distinguished by the co-ordination of its employees and their subjection to central authority. The discipline that prevails in the Weather Bureau is possibly the most striking trait of this branch of the public service, as it is certainly the one that makes most for the effective discharge of certain arduous duties which will be adverted to in the following paragraphs.

It would hardly be a figure of speech to say that the Weather Bureau, an offshoot of the United States Army, is to-day a little army in itself, or rather two—a field army of six hundred men,* widely scattered over the land, and a staff corps of two hundred, on duty at the headquarters of the service. It is of the six hundred men in the field that we first write.

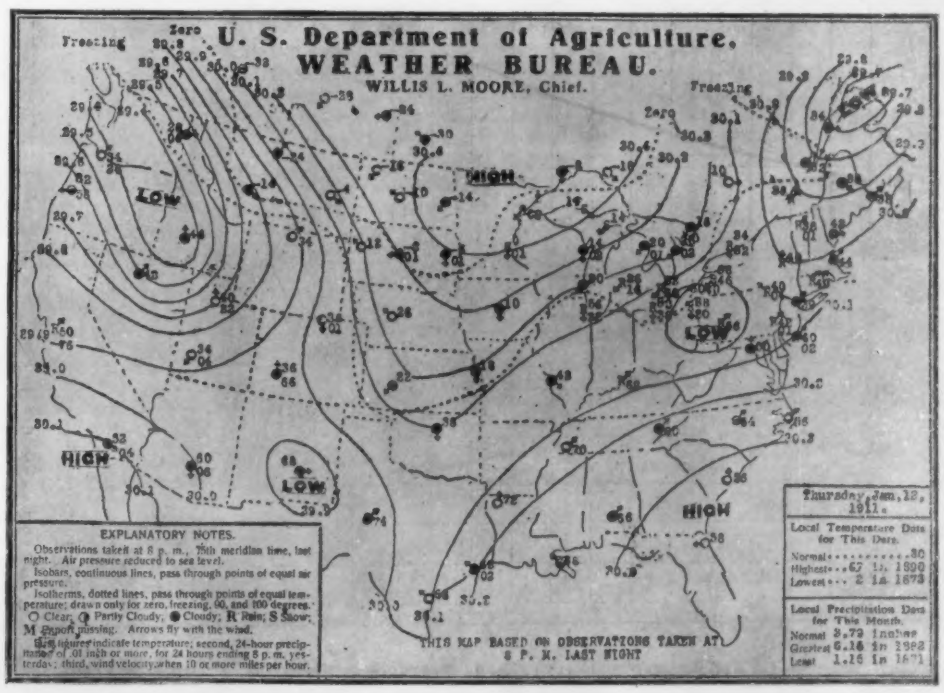

U. S. Department of Agriculture.
WEATHER BUREAU.
WILLIS L. MOORE, Chief.
HIGH
LOW
HIGH
LOW
HIGH
EXPLANATORY NOTES.
Observations taken at 8 p. m., 75th meridian time, last night. Air pressure reduced to sea level.
Isobars, continuous lines, pass through points of equal air pressure.
Isotherms, dotted lines, pass through points of equal temperature; drawn only for zero, freezing, 60, and 100 degrees.
○ Clear; ◑ Partly Cloudy; ● Cloudy; R Rain; S Snow; M Report missing. Arrows fly with the wind.
Three figures indicate temperature; second, 24-hour precipitation of .01 inch or more, for 24 hours ending 8 p. m. yesterday; third, wind velocity, when 10 or more miles per hour.
THIS MAP BASED ON OBSERVATIONS TAKEN AT 8 P. M. LAST NIGHT
Thursday, Jan. 12, 1911.
Local Temperature Data for This Date.
Normal 30
Highest ... 67 in 1890
Lowest ... 2 in 1873
Local Precipitation Data for This Month.
Normal 3.73 inches
Greatest 6.16 in 1902
Least 1.16 in 1871

Fig. 3.—The newspaper weather map.

The farmer who lives near enough to a large town to receive the newspaper map a few hours after publication need no longer depend upon the *ipse dixit* of the official forecaster; the weather of the whole country is laid before him and he may draw his own conclusions.

* *I. e.*, 582 commissioned employees, devoting the whole of their time to the work of the regular stations. There are, in addition, 1,349 special employees in the field who give a small amount of time each day to the work of the Bureau, and receive from $5 to $25 a month for their services. Finally, there are 4,754 "co-operative observers," who serve without compensation, except that they are entitled to certain government publications. The total numerical strength, including the employees of the Central Office, is 6,895.

It would be a congenial task to chronicle some of these instances, if it did not lie beyond the purview of the present narrative.

The officials and employees who man the two hundred regular stations of the Bureau are striving to make themselves useful to the community, even beyond the letter of the exacting commands laid upon them—with what success we shall try to see.

WHERE THE FORECAST FAILS.

Let us suppose that Farmer A wants to cut his hay, and is concerned about to-morrow's weather. He may have his own opinion as to the prospects of sun or rain, founded upon local indications, which he interprets according to his lights. Nevertheless, he seeks the opinion of the Weather Bureau, by way of the telephone. Here we must emphasize the fact that he *can* get the weather forecast by telephone from the local exchange, though the latter may be hundreds of miles away from the office where the forecast originated. This in itself is a signal example of the thorough way in which the Weather Bureau has organized the system of distributing its information. There is no need for the farmer to have recourse to "long-distance." The forecast is sent every morning, at government expense, to the telephone exchanges throughout the land, and to-day 3,681,000 telephone subscribers can get it in half a minute by merely calling up "central."

We will suppose that in this particular case the forecast says, "Fair"—which means no rain worth mentioning. A little sprinkle is neither here nor there. Our farmer accordingly cuts his hay next morning. The day waxes hot, in the afternoon thunder clouds gather, and Nature relieves her over-charged feelings by weeping copiously all over the farmer's meadow. Nature is often very partial in her attentions, and it may be that Farmer B, who owns the adjoining meadow, escapes the drenching altogether. Within the "forecast district" there are no general rains—only a local shower here and there—and the forecaster congratulates himself that he has hit the mark. Meanwhile our disgusted farmer is using language regarding the Weather Bureau that it is not for a mild-mannered bibliophile to record.

Well, then. The general forecast fails to fit the particular case—not once, but often. The local shower—particularly the thunder shower—is about the most uncertain quantity the forecaster has to deal with. The thunder shower is not a mystery to modern science; it has been dissected and classified, and its life-history has been written. There existed until very recently an international commission for the study of squalls and thunder storms, and there is a French *savant*—M. Durand-Gréville—who has devoted his life to the investigation of this particular branch of meteorology. We know that summer thunder storms, as a rule, move across the country in a long line like an advancing army marching "company front," and the position of the line has a more or less definite relation to the position of a general area of low barometer. In the light of our present knowledge there is a perfectly feasible method of forecasting the occurrence of such storms in a particular region, which consists in employing a great corps of special observers, stationed at intervals of a few miles from one another, and keeping a forecaster at some central point informed by telegraph or telephone of the behavior of each storm. With such an organization, after a thunder storm or a line of thunder storms had once begun its march 'cross country, its progress from hour to hour could be predicted with reasonable accuracy and warnings issued accordingly. Such a plan was recently tried in Germany in connection with the Aeronautical Exposition at Frankfort. The city was surrounded by a cordon of 85 special observers, each of whom was instructed to send an urgent message to Frankfort whenever a thunder storm made its appearance in his neighborhood. So efficiently was this programme carried out, that no one of the thirty-seven thunder storms that occurred during the three months of the exposition took the aeronauts by surprise. On a small scale, and for a special occasion, this method is, in a densely settled country, not only practicable, but relatively inexpensive. Each of the Frankfort observers received for his services a season ticket to the exposition, and the entire cost of the undertaking, including telephone and telegraph charges, was only $150—rather cheap insurance on scores of valuable aircraft and more valuable human lives. On a scale large enough to fulfill the requirements of a national weather service such a plan is out of the question, for many obvious reasons.

Then there is the thunder storm recorder, in its various forms—ceraunograph, ceraunophone, electroradiophone, and what not.

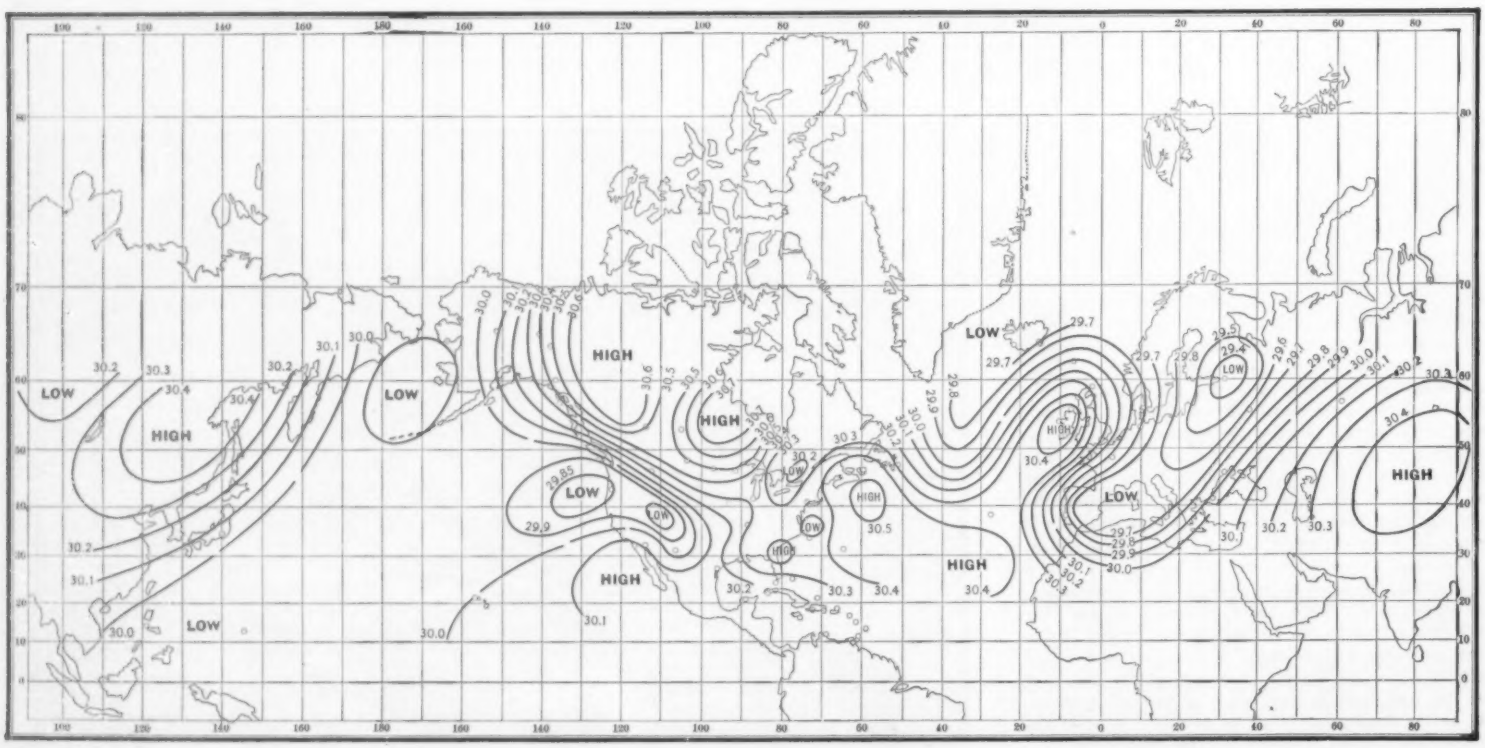
(*Continued on page 187.*)

Fig. 4.—The old idea in weather stations.

Its location is not ideal from a scientific standpoint, but was the outcome of practical requirements. Most stations are still of this type.

Fig. 5.—The new idea in weather stations.

In the new government-owned buildings of the "observatory" type, the instruments have a more satisfactory exposure. Forty-five of these buildings have been erected.


LOW
HIGH
LOW
HIGH
LOW
HIGH

The Small Motor on the Farm

What it has Contributed to the Farmer's Comfort

By L. W. Ellis

A HUNDRED years ago the production of the necessities of life kept four families out of five on the farm, and those four barely supported the fifth by their surplus products. Choice of occupations was necessarily limited. Since the invention of the steam engine, the manufacture of countless necessities has been transferred from farm to factory. The steam engine has made possible the wonderful development of our land and water transportation system. It has fostered the growth of our great centers of population, increasing the opportunities for employment away from the farm. The transfer of manufacturing to the city and the development of wonderfully efficient horse-drawn field machinery for crop production released millions of workers from the isolated life of the country. In consequence we have had for a generation the problem of making farm life more attractive.

It has remained for the engineer to accomplish what the agriculturist failed to do, and, naturally enough, by the same methods by which he made life away from the farm attractive. He is establishing easy means of communication and transport, devising conveniences for the farm home, and, most of all, he is introducing mechanical power to take from human shoulders the monotonous daily tasks that cannot be shifted to those of the animal. The agricultural world is awakening to the stunning fact that, after all, the farm is an engineering proposition. Production, to be efficient, must be organized on the same lines as in other great industries. The small motor is only the beginning of a wonderful development in agricultural engineering, and has greater significance than the importance of present installations would indicate. It is significant of the tendency to intensify agriculture by applying more power to each acre and carrying processes farther on the farm. It means the elimination of drudgery, the saving of unnecessary human labor, which is conservation of the highest type. It means the opportunity for exercise of mental rather than physical strength, the development of broader intelligence on the part of our farmers, with direct benefit to those who must depend upon the farmer's efficiency for their daily bread.

Electrical machinery has gone through wonderful development, and competition in commercial fields has at last brought the farm to the manufacturer's attention as an unworked source of trade. One of the papers at a recent meeting of the American Society of Agricultural Engineers was read by the representative of a large electrical concern, the title being, "The Promise of an Electrical Agriculture." The resulting discussion developed the fact that both engine and electrical manufacturers are looking to the farm for their greatest volume of business in the near future.

Without dwelling further on the economic phases of the question, we may pass to a consideration of some of the many adaptations of internal combustion engines and electrical motors to farm purposes. The discussion will be confined to those operations involving the saving of hand labor, the use of mechanical power in field work being a vast subject in itself.

The uses of the gasoline or kerosene engine on the farm are almost without number, but only the exceptional farmer has established a complete power plant. Pumping water by hand has long been regarded as impracticable, and in regions of unbroken topography the windmill has been generally unreliable. The latter's frequent failure in the summer, the time of greatest consumption, has led to a surprising shift to the small engine for pumping purposes.

In general the needs for water are for fire protection, sanitation, irrigation and consumption by household and stock. By the aid of the engine the farmer may have a better water supply than his city relatives. For instance, an elevated storage tank will give gravity pressure for faucets or hydrants all over the farmstead, and the newer pneumatic tank, underground, gives both pressure and insurance against freezing. In the latter the engine may be used to pump either air or water into the tank up to a pressure of from 15 to 75 pounds per square inch. It is now possible, by means of an engine, a compressed air tank and a submerged pump, to have abundant water direct from the well by simply turning a cock in the kitchen. The pump, located at least six feet under the water, may be started by turning the faucet, the air supplying power for operating the pump. A surprisingly large percentage of farm houses are being equipped with modern sanitary conveniences which contribute to the health and comfort of the family.

The engine has solved the problem of irrigation in many square miles of semi-arid territory where large projects are not possible or have been delayed. As a rule the engines used are of larger size than those used for general farm purposes, but in numberless instances the engines of from three to ten horse-power has proved the salvation of the farmer by supplying water for at least a small field.

Water can often be found at a shallow depth in dry runs or by boring. A five horse-power engine will raise 500 gallons per minute from a depth of twenty feet. Even in the favored Cornbelt and the East, the engine is being called on to keep crops forging ahead through the customary summer drouth.

Too often the only use of the small engine is for pumping water, or grinding feed, or some other one task. In contrast the writer has in mind a two-story power house on a side hill, visited over three years ago. The engine and pump are in the basement. Overhead is a line shaft, to which are attached at will the cream separator and churn, the washing machine (the boys do the washing and like it, because there is some inspiration in the chug and fuss of the engine), the corn sheller, fanning mill, feed grinder and grindstone. To all intents and purposes the building is a small industrial plant. There the farm office is located, the farm business transacted, the bulk of the farm stores kept, and many of the important processes of the farm carried on. All is system like that of the factory. There is activity without drudgery, the condition in any occupation which begets enthusiastic service.

Out in the dairy barn one clean, well-paid, trained dairy assistant now does the work of two slovenly farm hands openly rebellious at the tiresome job of milking. All that the farmer saves in money, perhaps, is the keep of one man, but in freedom from labor troubles and in general improvement of dairy conditions he gains in reputation and satisfaction of mind. The vacuum milking machine is responsible, with a gasoline engine off at the dairy house energetically minding its business of running the vacuum pump and the cream separator. Ten to fifteen cows per man per hour is the new standard of capacity, with far less work and dirt. The vacuum cleaning principle is applied to the cows by a slight addition to the equipment. All the dirt, loose hair and other foreign matter can be drawn off into a dust collector and removed. By the ordinary process of currying and brushing, these sources of contamination are stirred up to fly about the stable and settle upon the utensils. In dairies of fifty cows or less an engine of one and one-half horse-power is sufficiently powerful to run the four to six milkers usually attached and to handle other dairy machinery besides.

The livestock is rid of its surplus of old hair neatly and rapidly through the agency of a power clipping machine and a very small engine. The engine may assist in spraying the cattle for parasites, whitewashing and spraying the interior of the barn as a preventive measure. Spraying now extends to the orchard also, where insect and fungus enemies are successfully combated.

Filling the silo has rather grown beyond the limits of hand work, though it started in the same class with the work of chopping roots, corn, grasses, etc., by hand. All this work, heavy or light, may now be done by the gasoline engine, and the number of silos has increased in thirty years from less than one hundred to many thousands. One of the accompanying illustrations shows an engine of about twelve or fifteen brake horse-power handling close to seventy-five tons of corn fodder per day on ten to twelve gallons of gasoline.

The internal combustion engine for such work must have an excess over the average power requirements, as the load is irregular and the speed must be kept up in order to obtain efficient results from the ensilage cutter. On this account a heavy fly-wheel is added to equalize the motion of the engine. Again, some manufacturers, following the lead of the builders of large gas engines for heavy duty, are adopting the volume, or throttling, governor in place of the hit-and-miss type. In the latter the explosions are occasionally "cut out" by automatic action of the governor when the speed increases above the normal, to be resumed again when the absence of power impulses causes the speed to drop below normal. The throttling governor admits a charge for each cycle, proportioning it each time to the needs of the load. It is, therefore, slightly less economical on light loads than the hit-and-miss type, but for the heavy, irregular work of shredding corn, filling the silo, sawing wood, etc., it can be depended on to furnish steadier power.

"Bucking wood" no longer has its terrors for the farm boy. If the farm cannot afford the investment in a saw to go with the gasoline engine, there is very apt to be a neighborhood saw. Wood is not a perishable product, however, and farmers are often content to wait until the owner of a large outfit puts in an appearance and does the work on a custom basis.

One of the most exhausting chores in connection with the harvesting of the corn crop is shoveling off the load after a day of ten or twelve hours in the field. Now a two-horse-power gasoline engine, attached to a portable elevator, will empty a thirty-bushel load of ear corn into a car, corn crib or granary in from three to six minutes. The same is true to some extent of the small grain crops. Quite often both elevator and engine are mounted on the same truck, and in connection with the large threshing outfits this combination saves labor that is hard to get just at that time. The wagon is driven into position, the front wheels elevated and the rear end gate removed. The grain falls into the hopper, is elevated by an endless conveyor and delivered by a flexible spout at heights practically impossible by hand. The engine has therefore made it possible to build granaries and corn cribs higher, at a considerable saving in initial expense per unit of storage space.

On farms where heavy machinery, portable buildings, etc., have to be moved frequently from place to place, the portable gasoline engine equipped with a winch and cable is often indispensable. A five-horse-power engine may occasionally be seen putting a fifteen-ton tractor into a space on a storage floor which would not withstand the combination of weight and vibration produced by running the tractor under its own power.

It has been conclusively demonstrated that the horse is a more flexible traction power unit than the gasoline engine. He may be coupled up in teams of varying size, and in a pinch can pull to many times his normal capacity. At the same time, for driving rotary mechanism of fairly constant resistance, the engine has a great advantage over the horse in endurance. This is further emphasized by the loss entailed in transforming the linear motion of the animal's forward progress into the rotary motion of the machine. While a school of engineers in France has been arguing that the ideal farm machine should use horses for propelling it and the engine for performing its effective work, Yankee ingenuity has perfected the combination. From mounting a small stationary engine upon the frame of a grain binder, which was done repeatedly by inventive farmers before manufacturers grasped the possibility, we have now come to an engine mounted on wheels and connected by a shaft and universal joint to the driving shaft of the harvester. This outfit goes merrily up hill and down dale with two horses where four or five were formerly employed. It is especially adaptable to cutting rice or grain on soft ground where the traction wheel of the binder could not grip the surface firmly enough to transmit the required power.

To the average farmer electricity is a mysterious agent, to be gingerly dealt with. Up to date the widest use of electricity on the farm is for lighting and for the light tasks about the house. Current for general power uses has usually proved more costly than power derived from the gasoline engine, and the kerosene engine has even further increased the handicap. Moreover, the engine, as a self-contained and easily portable unit, is much more convenient for use at different points. In isolated cases, however, a small stream has been harnessed, and even at a considerable cost for electrical equipment, been made to furnish cheaper and more convenient power than the engine.

Improvement in the storage battery has widened the use of gasoline-electric systems. A two-horse-power engine will furnish a horse-power hour for 0.15 gallon of gasoline on full load and on 0.2 gallon at half load. As many tasks require less than full load, the storage battery has been made to economize by taking up the surplus power. On the average farm it is seldom necessary to run the engine simply to charge the battery, hence the lights may be said to cost little or nothing outside of the cost of installation and the periodical restoration of the battery electrodes. The storage battery is a great convenience. It is a necessity with the hit-and-miss governed engine if a clear, steady light is to be had. Some types of engines with throttling governor control have proved very satisfactory when coupled direct to generators. This connection requires, of course, that the engine be run as long as lights are required, and

unless some such work as pumping necessitates running the engine at night, the outfit would probably be useful only on large farms where a number of buildings are to be lighted.

Low voltage systems are commonly offered to the farmer on account of safety, simplicity and low operating cost. The improvement of the low voltage tungsten lamps, consuming about one-third the current required to operate the ordinary carbon filament lamp, has made it possible to reduce the size and cost of installations, especially in the matter of storage batteries. The fifteen-light plant is probably the most popular, as more than that number are seldom burned at one time. With this outfit it is possible to wire for twenty or thirty lights, and burn the entire number by running the engine and dynamos and taking current from the battery at the same time. The fifteen-light outfit requires about one-third horsepower and the thirty-light about three-fourths horsepower, but less than a two-horse-power engine is seldom installed. The total cost of engine, generator, storage battery, switchboard, wiring, fixtures and lamps, for a fifteen-light, thirteen-volt outfit is around $400. The light will cost in the neighborhood of one one-hundredth of a cent per candle-power hour. For installations covering considerable area it is advisable to use a higher voltage, i. e., twenty-five or thirty.

With the development of interurban railways and long-distance transmission lines it is frequently possible to obtain current from the central station at lower cost than from individual plants. Communities are to be found where the use of electricity for light and power is practically universal, and community central stations are developing in the same manner as did farmers' telephone lines a decade ago. The installation of low voltage apparatus for individual plants requires radical change in equipment when central station power is finally obtained.

The small electric motor is especially convenient about the farm house, attached to a fan, a flat iron, a churn or a washing machine, for the housewife has but to turn a switch to secure relief from heat and weariness. The electric range and chafing dish can hardly be said to be in general use, but the vacuum cleaner is coming into its own. For $100 the mistress of the household is equipped to clean carpets, floors, upholstering, drapery, etc., by suction at a cost of three cents per hour. The blowing attachment chases dust from inaccessible places. The outfit may be used even for the lady's massage and drying her hair. A motor of one-sixth horse-power furnishes power for all.

A supply of soft water under pressure, independent of the farm supply, can readily be obtained from a cistern, a pneumatic tank, a rotary pump and a motor of one-fourth horse-power. Convenience rather than cheapness has been the means of popularizing the electric motor, and it is only natural that it should appear oftener in the home than in the producing end of the farm.

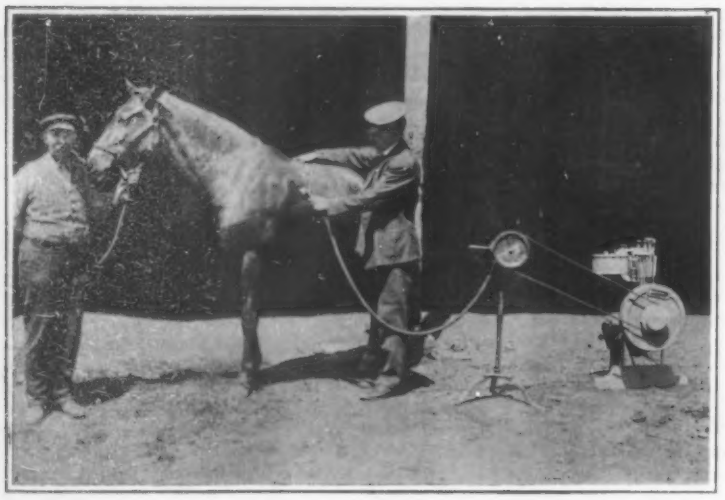
A friend of the writer's even applied electricity to the farm fence. He drove 2-inch × 2-inch sticks about four rods apart surrounding a pasture field and strung two No. 15 wires thereon, properly insulated. As a starter he connected up a tiny dynamo, driven by water power, with his fence wires. By carefully introducing the various animals to the fence before turning them into the pasture, he educated several to give it a wide berth. The others, however, showed a supreme disregard for the fence, and after the most carefully educated mule, in a panic, took out several panels the inventor quit in disgust.

This discussion has hardly covered all the farm uses of the small internal combustion engine and the electric motor. Enough has been said, however, to justify the statement that one of the greatest present needs of the farm is a comprehensive inquiry into the subject of power installations. These motors are working revolutionary changes in the social and economic status of the farm laborer. But there are no state or national publications on farm power questions to compare with the concise, scientific, helpful series on every other topic.

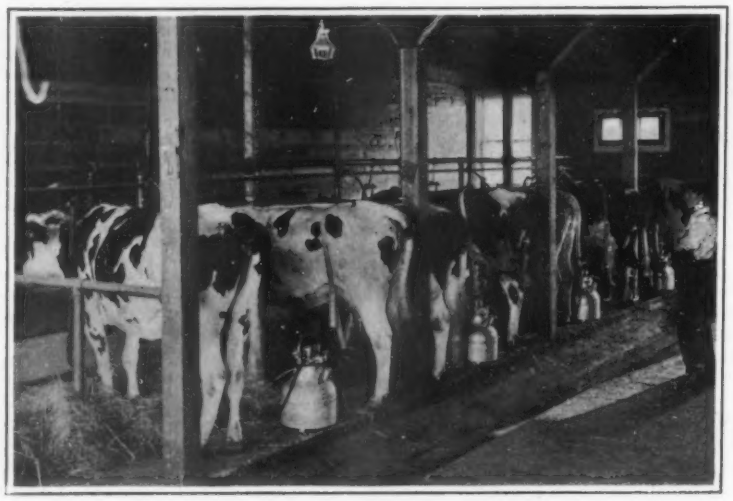
The writer has long advocated the need of a branch devoted to agricultural engineering in the United States Department of Agriculture. On account of the breadth of the subject the State colleges do not as a rule have the necessary resources to investigate all phases of agricultural engineering, and under the present organization the subject of farm power can receive but little attention. The interests of manufacturer and purchaser are identical. It is gratifying to note that the National Gas and Gasoline Engine Trades Association, representing the makers of internal combustion engines and accessories, has joined hands with the American Society of Agricultural Engineers, representing the college men and farm machinery manufacturers, to urge upon Congress the organization of a Bureau of Agricultural Engineering at Washington to cope with the situation which is so rapidly assuming importance.

Internal combustion engine fighting the codling moth.

Farm pump engine taking the place of a blown-down windmill.



Mechanical horse clipper in use.



Milking cows with hydraulic apparatus.

Gasoline engine employed in irrigation.

A gasoline engine "bucking wood."

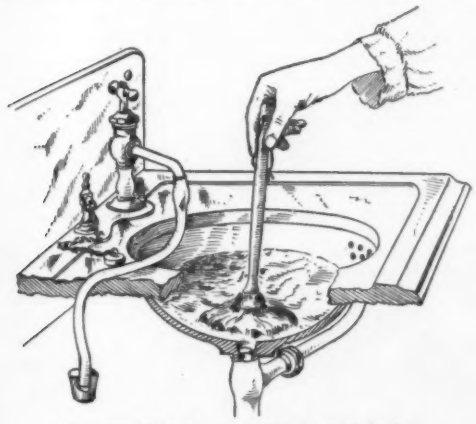
THE USEFULNESS OF THE SMALL MOTOR

[The Editor of Handy Man's Workshop will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

Starting a Clogged Drain

By B. F. Albert

AN easy method of starting a flow of water in a wash basin when the drain is clogged is as follows: With stopper removed, fill the basin half full of



Two methods of starting a clogged drain.

water. Take a swab and work it up and down rapidly in the water. This sets up a pumping action that agitates the water in the pipe violently. Nine times out of ten it will bring the sediment right up from the trap, and start a flow of water. If flushing is desired, take a cork that will fit the drain in basin, cut a hole through it, and attach a piece of rubber tubing to it, as shown in the drawing. Draw the other end of the tube over the faucet, place the cork in the basin drain, and turn on the city pressure. It may be necessary to hold a cloth over the drainage holes in upper part of basin. This wrinkle will save dollars in plumbers' bills, as I believe it is as efficient as a plumber's pump.

A Talk About Bits

By Charles Cloukey

ALTHOUGH the common stock bit is a tool of almost universal use, there are some sensible and even scientific practices which are little known by the common run of people who use the brace and bit.

There are several different kinds of bits, and each kind made for its special use, although they are often used interchangeably both through ignorance and be-

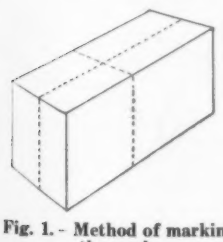


Fig. 1.—Method of marking the work.

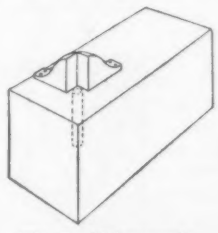


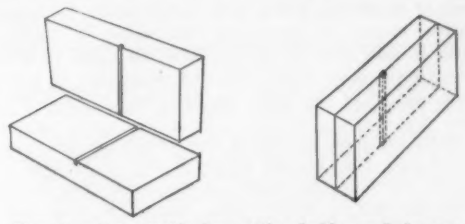
Fig. 2.—Using angle brackets to guide the bit.

cause the workman does not have the full equipment in his tool chest.

The gimlet bit for screw holes, the center bit for the shallow holes of the cabinet and stair builder, the ship auger bit for the long holes in heavy timbers, the Fostner bit for ornamental work, the drill bit for center boring and for quick holes in soft wood, the expansive bit for all kinds of large and odd sized holes and the spur auger bit for general use and expert work, comprise the outfit.

It should be needless to say that all kinds of bits should be straight and sharp. The drills and gimlets should not be ground on the outside as that will reduce the diameter at the cutting edge and so hold the sharp edge away from the wood. The spur bits should be kept filed so that the spurs are longer than the lips or there will be a rough or ragged hole. Bits should be whetted after filing so as to give them a smooth keen edge.

When boring a hard piece of wood, much friction and consequent labor may be avoided by a liberal application of machine oil in the cut. In similar cases when using a machine auger and the work is too hard for the belt to pull, the work may be modified either by filing the threads off the point of the bit, or by boring a center hole in the stock with a drill bit just large enough so that the threads will not lead the bit, and still small enough so that the bit will not chatter in the work. If there is no



Figs. 3 and 4.—Guide for cutting half-round grooves.

screw feed, the workman can regulate the pressure by hand so that the belt will be able to do the work, although at a reduced rate, which is the scientific result of the method.

Fig. 1 shows the method of marking a piece for boring a hole straight down through, and is practised by men who have become expert in the use of the brace and bit.

Fig. 2 illustrates the use of two little brackets tacked or clamped to the face of the work in which the hole is to be bored, and in such a manner as to form an angle in which the bit is to stand until the hole is deep enough to carry true of itself.

Fig. 3 shows a shallow saw cut in the faces of two pieces out of which is to be cut a half round groove.

Fig. 4 shows the two pieces in position for boring and the purpose of the two cuts becomes apparent as the lead for the screw of the bit.

Fig. 5 shows a problem somewhat similar to the last, but is used in such cases as boring a shaft hole in a pulley or a bushing where a little space is required for draft. The two thin fillets are placed between the pieces with their edges just far enough

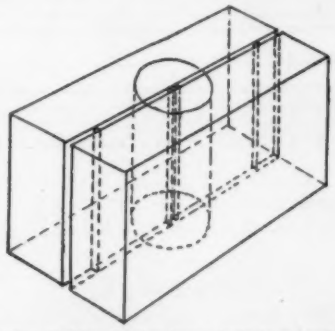


Fig. 5.—Guides for boring a hole in a bushing.

apart to form the lead where the hole is desired to be bored. It is better to make the bushing of two parts and bore as shown if it cannot be bored first and then turned up afterward.

Fig. 6 illustrates a practical method of boring large holes by means of the expansive bit. The outside circle is the perimeter of the hole to be bored and the dotted line near the center is the solid wood to be left for the engagement of the inner lip and spur. The smaller circles represent holes bored with a smaller bit in order to remove the bulk of the wood and relieve the strain on the extension. Care must be taken that the small holes do not cut the core loose from the outside, or the attempt will be a failure. The small holes should be so arranged

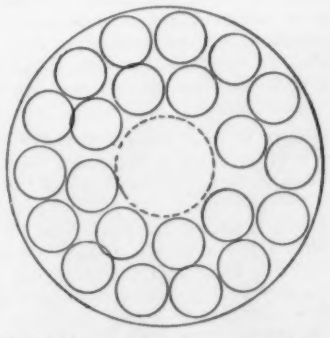


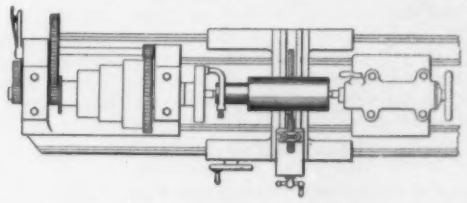
Fig. 6.—Preparing for a large bore.

as to break up the continuity of the radial lines as thoroughly as possible, and should not break into the track of the outer spur. If the wood is very hard and tough like hickory, the holes may be quite close together and still hold the strain of the finishing cut, but if the wood is soft and weak there should be more space between the holes for the reason named.

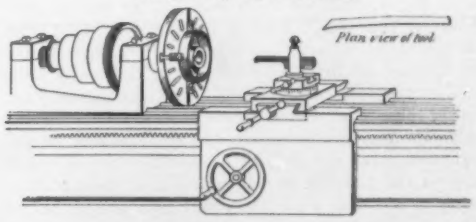
Gimlet bits should never be used for the purpose of boring straight center or lead holes, as a slant of the grain is liable to carry the point out of line. The tool for this work is a very sharp drill bit with little more bevel than is required for iron.

Cutting Keyways on a Lathe

IT is a simple matter to do some of the work of a shaper or of a milling machine on a lathe. For instance, a keyway may be cut on a lathe, either in the shaft or in the pulley, by keeping the work stationary and moving the tool as in a shaper. To cut a keyway in the shaft, put the work on the centers, and taking a square-nosed finishing tool, lay it on liners on its side, so that the tool will be in line with the centers. Clamp it in place by means of two bolts. Wedge the dog that holds the work from turning, so



Cutting a keyway in a shaft.



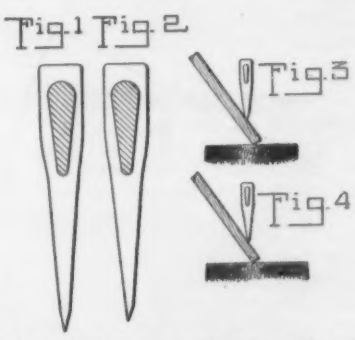
Cutting a keyway in a pulley.

that there will be no backlash or play. Now throw in the back gearing, and run the tool into the work by operating the carriage back and forth. The tool may be fed in at each cut, and in this way a neat keyway may be planed in the shaft, as shown in the first engraving. To cut a keyway in a pulley, secure the work in the chuck, and use a boring tool ground to the width of the keyway, and shaped as shown in the illustration. The carriage may be run in and out, and the tool fed into the work by means of the cross feed, as before.

Hints on Cutting Stakes

WHEN sharpening the ends of bean poles and other stakes to enable them to enter the ground easily it takes several blows with the hatchet to obtain the desired effect.

All this trouble may be entirely done away with if you take care to sharpen the axe properly. When sharpening an ordinary ax or hatchet you first put one side against the grindstone and then the other, thus



How the ax should be ground for sharpening stakes.

making a bevel on both sides as in Fig. 1. But, instead of doing this, allow one side of the hatchet to lie nearly flat on the grindstone. Then lay the other side on the stone and put a bevel on it in the ordinary way. Now the hatchet has an edge like a wood cutting chisel (Fig. 2.) When pointing stakes let the flat surface, which must be the left side when the edge is pointing away from you, be nearest the wood. Lift up the ax and with a slight pressure let it drop on the end of the wood stake. It will be found to enter quite easily instead of glancing off the wood as often happens with the ordinary hatchet and the resulting cut will be straight as shown in Fig. 4, instead of being curved as shown by dotted lines in Fig. 3.

With this edge only half as many strokes and half as much energy need be used over a job and the

work will possess the advantage of being far more neatly done.

Simple Methods of Surveying

ONE is apt to think of triangulation as an abstruse method of calculation, involving the use of fine instruments and higher mathematics. It is not always necessarily so, for one may often measure distances to inaccessible points, with a sufficient degree of accuracy, with very crude instruments and with no special mathematical effort.

Let us suppose, for instance, that we want the dis-

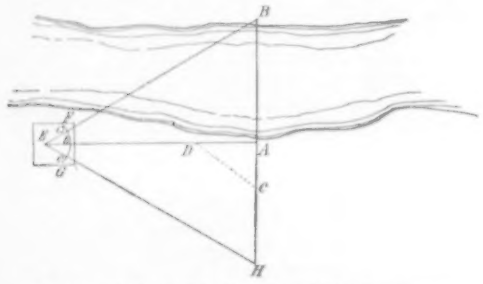


Fig. 1.—Method of finding the width of a stream.

tance across a river. We will select some fairly conspicuous object on the other side, as a tree or rock at *B*, Fig. 1, then set up a stake, *A*, at the opposite point on this side. Exactly in line with *A*, *B*, and six feet from *A*, set the stake *C*. It is well to use low stakes and drive a small nail in the top of each as a center to measure from. Now take a tape line, fasten the end at *A* and secure—or have an assistant hold—the eighteen-foot mark at *C*. Take hold of the eight-foot mark and pull both sides tight; which will give us the point *D*, at which to set another stake—being sure not to omit the small nail in the top to mark the exact distances. Sight along *A* and *D* and have an assistant place a stake at *E*, exactly in line with *A*, *D* and at any convenient distance. If the work has been carefully done the line *A E* will be exactly at right angles with *B C*.

Take a board or table, as large as is convenient, place it level and drive a nail directly over the point *E*; having first struck on it, with this point as a center, the arc *F G*. Sight across the nail *E* to the point *B*, and set up the nail *a* on the arc and exactly in the sight line. Also set a nail, *b*, on the arc and on the line between *E* and *A*. On the arc, measure off the distance *b c* equal to *a b*, and set another nail at *c*. Sight across *E c* and have a stake set at *H*, in line with *A B*. The distance *H A* will be the same as *A B*.

Now that we have the instrument made we may as well use it to measure the height of that tree we have been arguing about. The instrument, you understand, is the board or table with the arc struck on it. To use it for this purpose it will be necessary to set it on edge, plumb, and with the line between the points *E b*, level and pointing at the base of the tree. Set the nail *a* in line with the top of the tree,

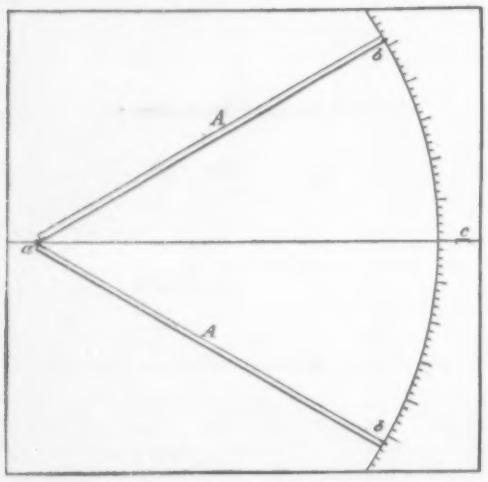


Fig. 2.—A simple surveying instrument.

and then lay the instrument flat, making *E b* again point at the tree. Measure off the distances *A C*, *A D* and *D C*, 6, 8 and 10, as before, thus locating the line *A H* at right angles with *E A*—*A* being now the tree. Sight along *E a* and place the stake *H*. *A H* will equal the height of the tree.

If one desires he can easily make an instrument which can be worked more quickly, and which will be accurate enough for most practical purposes. Fig. 2 shows a plan view of such a one, while Fig. 3 shows one of the arms in detail.

A smooth dry board, so cleated that it will not warp—and the larger the better—is best for the base. Get out two straight sticks, *A*, *A*, of thoroughly seasoned wood, about ¾ by 1¼ inches. Take a nicely made brass or steel butt; and, if the pin is not already loose, file off the end so that it may be removed. Set half of the butt in one end of each of the sticks so that the center of the hole will be in line with the side, as *a* in Fig. 3. On the other end of each of the sticks, which must be of exactly the same length, secure the pieces of thin metal, *b*, setting them in half their thickness, allowing them to project a trifle beyond the ends and using care to have each exactly in line with the half butt at the other end.

Mark the line *a c* along the center of the base board (see Fig. 2) and strike an arc, *b b*, with a radius equal to the length of the arms just made. This arc may be divided into degrees, or into convenient units, provided they are equal on both sides of the line *a c*. Get a straight wire which will fit the hole in the butt, and drive it through that hole into the center from which the arc was struck on the base board, using great care to have it perpendicular thereto. This wire, and the pieces *b b* may be of any convenient height; but that height should be so limited as to avoid danger of their getting bent. It is also needful to have an upright wire, or strip of metal, at *c*; and one may have the wire *a* project through the base and form an eye below it, wherefrom a plumb bob may be hung.

In using this instrument it may be set up on any convenient support; as a camera tripod, with the line *a c* aiming at the point corresponding to *A* in Fig. 1. One arm is swung till the line of the wire, *a*, and the sight, *b*, is directed toward the point *B*,

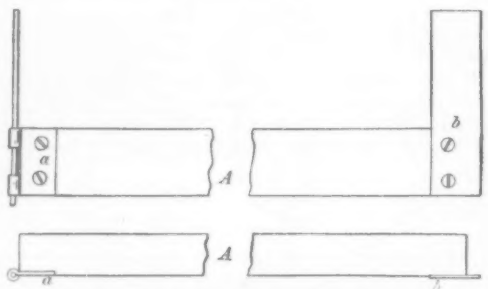


Fig. 3.—Details of the swinging arm.

when the other arm may be quickly set off by the aid of the graduations on the arc, to an equal distance on the other side. The rest is the same as previously described.

Shop Notes

Sawing Thin Bars.—Those who have had the job of cutting thin brass or copper tubing with the hacksaw are acquainted with the difficulty usually encountered as a result of the tendency on the part of the saw to bite into the walls of the thin tubing. This difficulty can be easily overcome. An old hacksaw blade, which has outlived its usefulness, is all that is necessary, and therefore the method is one that fits in well with shop economy. The teeth of the blade are first ground down with an emery wheel until only very small teeth projections remain.

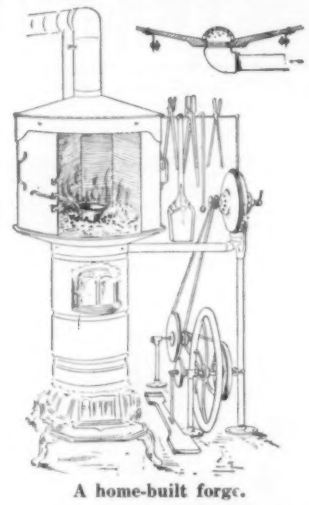
Cutting Off Steel Shafts.—The following little kink may be appreciated by many machinists who have had more or less trouble when cutting off steel shafts. By simply turning the cutting-off tool upside down, and running the lathe backward, it is possible to almost entirely eliminate any digging in of the tool. This method will be found to be far superior to the ordinary method of cutting off stock. Of course it works to better advantage when using a cutting-off tool. It is necessary that the lathe be reversed, or, if the cross-slide permits of the tool being placed on the opposite side of the lathe in the rear, then the reversing is unnecessary.

How to Remove a Wood Screw.—A handy way of removing a wood screw that has stuck, and is so tight that there is danger of twisting off the head, is as follows: Heat a poker or a piece of round iron red hot, and hold it against the screw head for a little while. Wait a few minutes for the screw to cool off, when it will be found that the screw can be removed quite easily with the same screw driver that just previously would not perform the work. The explanation is simple. The red-hot poker heats the screw, the screw expands, and makes the hole it is in just a bit bigger. The screw then cools down and resumes its original size, leaving the hole in the wood a size larger. The writer has given this little kink a fair test in taking screws out of some oak boards that were built in a refrigerator where the wood had become set around the screws.

A Home-built Forge for the Workshop

By Albert F. Bishop

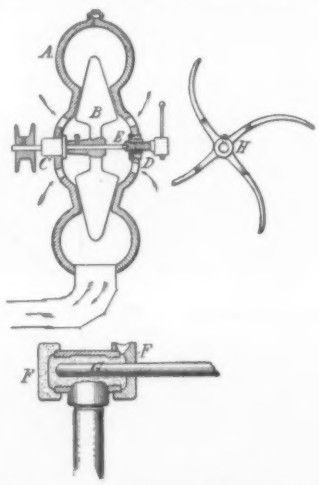
THE forge here illustrated was built at home in a simple way. A bowl-shaped casting was mounted on a small stove which answered as a pedestal and also reduced the floor space for the forge. The upper part was made of sheet iron extending down to the bowl-



A home-built forge.

shaped casting. Two sliding doors were curved to fit the bowl-shaped casting and the sheet iron drum enabling one to open and close the door as desired. The illustration shows the arrangement of smoke pipes for the stove and forge. A sketch at the top shows the tuyere iron which is a small dome-shaped casting with a few holes drilled in the top to permit the air blast to pass through. The tuyere iron was simply laid on, its own weight keeping it in place.

The blower case was made of wood in two halves turned in the lathe. The sectional view marked *A* shows the shape. The fan was made of metal. In making the pattern, the part marked *B* was turned in the lathe and sawed out with a fine saw to the shape shown at *H*. This made all the blades of the same form and shape, a result which would have been difficult of attainment if the fan had been made in separate parts. It was essential that the blades revolve quite true and close to the case at the *V*-shaped edges. At *C* is a hickory bearing inserted in the shell *A*. The opposite side of the shell has a piece of metal inserted with the thread cut that receives a hickory screw marked *D* forming the opposite bearing of the spindle which is simply a tapered center. This has proved quite durable and has lasted a number of years without renewal. Holes were bored through the case around the bearings to furnish an inflow of air. The counter-shaft is simply a smooth shaft held in place by a fine cup-shaped piece *F* that was turned in the lathe. A thin piece of paper was wrapped around the shaft at *G* and Babbitt metal was poured into a pipe fitting which formed the hanger or bracket for



Sectional view of the blower and the countershaft bearing.

the bearings. The bearings made in this way are quite simple, as the shaft does not need any collars to prevent side motion. The general arrangement of balance wheel, pulleys and belting, hangers and pedal is quite clearly shown in the sketch.

The following are a few of the principal measurements: Extreme diameter of blower shell or case 8½ inches, blower shaft 5/16 of an inch in diameter, counter-shaft ¾ of an inch in diameter, fly-wheel shaft ¾ of an inch in diameter. Keep the journal as small as possible on any foot-power machine, as it helps to reduce the friction and make pedaling easier.

The Inventor's Department

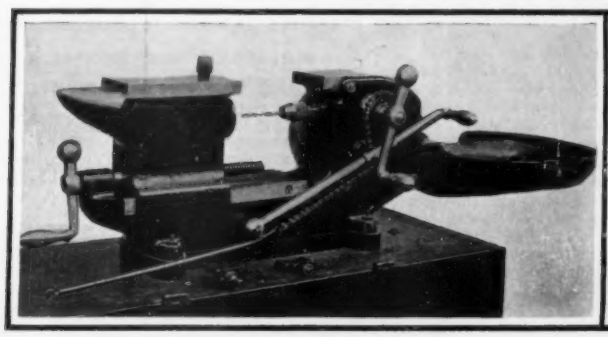
Simple Patent Law; Patent Office News; Inventions New and Interesting

A Tool with Many Uses

By Jacques Boyer

A FRENCH inventor named Sellier has devised an apparatus which he calls the Universal, because it constitutes a whole work shop in itself. Although it occupies little space and weighs only 132 pounds, it comprises a forge, an anvil, a boring machine, a vise, a work bench, a grindstone and a punch.

The steel anvil, which can be moved along the cast iron base of the machine by turning a screw, forms one jaw of the vise. The other jaw is a fixed steel block attached to one end of the base and provided with a tool head and screw clamp for the attachment of drills and other tools. This end of the machine also carries a dust-proof tool box and a grindstone. At the other end is the forge, which is simply an iron pan, connected with a blower, placed under the grindstone. The forge can be removed when it is not needed. Power is furnished by a treadle or otherwise. The transmission is devised to give either a low speed for boring, etc., or a high speed for grinding. The construction and uses of the Universal machine require no detailed verbal description, as they are clearly illustrated by the accompanying photographs.



Set up for boring.

Working with the vise.

Sharpening a tool on the grindstone.

The Universal as an anvil.

Cutting pipe on the Universal.

The Universal as an anvil and forge.

VIEWS ILLUSTRATING THE VERSATILITY OF THE "UNIVERSAL."

The Solution of a Riddle

By Sir Hiram Maxim

IN the winter of 1884-5, when it was announced in the London newspapers that "an American engineer having a workshop in Hatton Garden had invented a totally new form of a machine gun that actually loaded and fired itself over 600 rounds in a minute from a single barrel and that all the gunner had to do was to sight the gun and touch a button, the recoil energy being utilized for working the mechanism," it can be imagined that such an extraordinary statement was not accepted as being a fact. Some said it was altogether too good to be true; others said that the statements should be taken with a grain of salt, and not a few put it down as another case of Yankee brag and bluster. But the little gun was very much in evidence, and when H. R. H. the Prince of Wales had visited my workshop and fired my gun, other members of the royal family followed, and it was not long before it was considered quite the thing to visit Maxim's workshop and fire his gun. The number of visitors that I had can be judged from the fact that over 200,000 rounds of government cartridges were used in showing the gun to visitors. This had not been going on long before I received a communication from the War Office stating that a large number of War Office officials intended to pay me a visit on the following day at 11 o'clock. Of course I was on hand and ready. Among the high officials were Lord Wolseley, General Sir Andrew Clark, Surveyor General of Fortifications for the British Empire, and many others. I fired the gun myself and allowed the officers to fire; everyone was amazed at the rapidity with which a single barrel gun could be fired. They said: "Indeed, it is a revelation; no one would have believed it to be possible"; and all agreed that it would work a revolution in military tactics. I was very much congratulated on my success and my skill as a mechanician.

In about an hour they had all left except one officer, General Sir Andrew Clark, who said: "Mr. Maxim, I wish to have a quiet word with you." I took him into my little office and gave him a seat. He said, "I am an Irishman. I have always greatly admired Americans; they appear to me to be the cleverest people in the world. You have certainly done some very clever work since you have come to England, and I have been thinking that I might turn some of your cleverness to account for the benefit of the government. We have a certain mystery at the War Office that none of us are able to solve; perhaps you, being a real Yankee, may be able to give us a solution of the problem. At any rate, come to my office at the Horse Guards to-morrow morning at eleven precisely and I will tell you what the riddle is that we have to solve." Of course I was on hand. Precisely at eleven o'clock I stepped into the general's office. He touched a bell, his orderly entered, and was told to fetch Capt. Clark. Up to that time I had not the least conception as to what the mystery could possibly be.

Sir Andrew opened proceedings about as follows, which I quote as near as I can remember it: "I suppose you are aware that the Germans have recently brought out what they call a slow burning cocoa powder for use with artillery. We have experimented with this new powder and find it to be very good indeed. It is an excellent powder; it gives high velocities with phenomenally low pressures. The reason why this powder is not black is because the charcoal is not carbonized at a very high temperature as is the case with ordinary charcoal. There is still a little hydrogen left in it, therefore its brown color. It is an extremely easy matter to analyze gun powder. First you dissolve out the niter with water, and then dissolve the sulphur, which will leave the charcoal. We have found nothing in this powder except charcoal, niter and sulphur. It has been analyzed by our best chemists, each working independently of the others, and they all give us exactly the same formula and state that they can find nothing in it not found in common gun powder, except a trace of hydrogen which comes from the imperfectly charred wood. We have made considerable quantities of this cocoa powder in England and have had no trouble whatsoever in preparing the brown charcoal and making the powder. The weight and appearance of our powder is identical with that of the German powder, and when the finished article is analyzed it is found to be exactly the same. Still, when we come to fire our powder in a gun its action is quite different from that of the German powder. Our powder produces high pressures and gives us low velocities, while the German powder, on the other hand, gives low pressures and high velocities. We have repeatedly consulted our greatest chemists and also many other scientific men of the highest order and still we are as much in the dark to-day as we were when we first attempted a solution of the mystery. The German makers demand a very high price for the secret and we are practically at the point of paying the large sum of £35,000 for the secret, which seems to be absurd when we take into consideration that the weight and chemical constituents of this German powder are identical with our own. Now as we have absolutely failed to find out what the secret is, after months of study and experiment, I have thought that perhaps you, as an American, might find a solution and save us the £35,000."

To this I replied: "Sir Andrew, I thank you for the compliment that you have paid me, but I have never imagined that Americans are cleverer than Englishmen. In science, especially chemical science, I am not in the same category as the distinguished professors whom you have mentioned; still I have already solved the problem; in fact, you yourself have practically explained it to me in words which I fully understand." "Impossible!" "Nevertheless, you have told me, and to-morrow I will, with your

permission, come to this office at the same hour, when I shall be able to explain to you what the difference is between the two kinds of powder in language that you cannot fail to understand; in fact, I will give you a demonstration."

Sir Andrew was amazed; he thought it was too good to be true. I then pointed to two hats on the table and said: "If I come into this room and you tell me that there is an orange under one of those two hats, and I pick up one of them and fail to find the orange, I then draw a logical conclusion; the orange is under the other hat. You have already told me what the secret is not, and tomorrow I will tell you what it is." Sir Andrew then gave me a block each of the German and English powders. I took them to my workshop, and after polishing the surfaces of the two blocks, I first examined with my microscope the English and found, just as I had expected, that the highest power that could possibly be used on an opaque body showed nothing but a homogeneous smooth surface; evidently the constituents were very finely ground and intimately mixed. When I came to examine the German powder, this, too, was exactly as I had expected—the sulphur and the charcoal were very finely ground and intimately mixed, but the niter was granular. I measured the grains and found that the largest had a diameter of 0.005 inch and that the smallest appeared to have a diameter of 0.001 of an inch. This, of course, was a complete solution of the mystery, and the next morning promptly at eleven o'clock I again visited Sir Andrew's office, taking my microscope and the powder with me. He saw the point at once and said he was simply amazed that their scientific men had not been able to find out what the difference was. It was only too evident that they had relied altogether on chemistry, when, as a matter of fact, it was not a question of chemistry at all.

Of course he congratulated me very strongly and had much to say about the common sense of Americans. A few days later I visited a powder factory and made about fifty different grades of powder, all the way from very slow burning up to one of very great rapidity of burning. The process of making the various kinds was extremely simple. I first weighed out the charcoal and sulphur and kept them in the mill for about three hours, when they were very finely ground and thoroughly mixed. I then added the niter, which was already in a fine granular condition, and when it had been in the mill for ten minutes I took out a specimen—this was my slow burning powder. I took out other specimens, at first every two minutes, then every two and a half minutes, then every three minutes, and so on. Of course the last would be the quickest burning powder. I took these specimens back to London with me and arranged a lot of V-shaped channels about eight feet long. These I placed side by side and filled the first one with the slowest powder, then the channel on the opposite side with the quickest powder, and between these I had the powders arranged in their order of rapidity of burning, and all the ends were connected together by some very fine and quick powder. I then invited Sir Andrew and his assistants to witness my experiments. I touched off the quick powder and the flame ran down the channels in such a manner that the burning ends of the powder in the grooves were practically in a diagonal line. By the time that the fastest burning powder had been completely consumed, the slowest burning had not been consumed an inch. This demonstration proved beyond all possibility of dispute that powders of all degrees of rapidity of burning could be made by simply varying the size of the grains of niter.

This was my first experience in explosives, but I continued experimenting for years and took out a large number of patents.

Statistical Data in the Annual Report of the Commissioner of Patents.

LAST week we noted some of the salient points in the main body of the Commissioner's report. We have now before us tabulations and statements in figures on the progress of the Patent Office during the past year, and since the beginning of the present series of patent issues in 1836.

This portion of the report also shows a number of interesting facts, from which some of the chief are selected for reproduction here.

The balance sheet for the past year shows a surplus of $19,824.75. This makes the total accumulated surplus up to December 31st, 1910, $6,998,227.64.

The total number of applications for patents (including designs) during the year was 64,448. The total number of issues was 35,807, to which may be added 11,336 applications allowed, but awaiting payment of the final fee.

There were also 7,442 cases forfeited for non-payment of that fee. Reissues numbered 123.

An interesting table is given, showing the inventive activity of the several States of the Union. Connecticut stands first, with one patent issued to every 1,126 inhabitants. It is somewhat surprising, perhaps, to find the District of Columbia second on the list, with one issue to every 1,329 inhabitants. Then come in order California, Massachusetts, New Jersey, Colorado, Illinois, and occupying the eighth place, New York, with one patent issued to every 1,841 inhabitants.

The participation of foreign countries in invention protected by United States patents is shown in another instructive table. The total number of issues to citizens of the leading countries was as follows:

Germany	1,083
England	894
Canada	534
France	315
Austria-Hungary	139
Sweden	124

This exhausts the list of those countries whose contributions run into three figures.

The order is somewhat different when we come to consider the total number of patents secured by the several countries themselves. To the end of 1910 the figures are as follows:

Total foreign countries	2,138,091
United States	990,134
France	440,898
Great Britain	425,374
Germany	248,106
Belgium	237,500
Canada	133,690

The growth of the business of the Patent Office is brought out by a comparison of the figures for the years ending respectively December 31st, 1899, and December 31st, 1910.

The increase thus shown is as follows:

	Per cent
Receipts	52.8
Expenditures	65.5
Applications and caveats filed	59.6
Patents, designs, etc., granted	46.3
Number of employees	40.8

It will be noted that the number of employees has not been increased in proportion with the increase in business transacted.

On the other hand, the standard of the examining corps has been raised by the increased stringency of the civil service examination for appointment on that staff, and by the additional inducements in point of salary offered to well-qualified men to enter and remain in the service. The work of the classification division also should result in an increased efficiency, and this may have to be taken into account in considering the growth of the staff, although presumably the full benefit of the work of this division will not be felt for some time to come.

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

The weekly *Index of Patents* issued by the *United States Patent Office* will be found in the *Scientific American Supplement*.

Of Interest to Farmers.

BROOM CORN PRESS.—J. J. FAUCHER, Wichita, Kan. The object of this invention is to provide a press which will be efficient for its purpose, practically devoid of danger to the operator or press from careless handling, and which will enable the bale to be speedily compressed, tied, and discharged. A simple means is provided for automatically releasing the door when the bale is compressed.

HAY RETAINING DEVICE FOR HAY STACKERS.—J. O. MCCREERY, Denver, Colo. The apparatus consists of a series of parallel teeth rigidly attached to a cross bar constituting the head of the frame and which is adapted to slide on the ground. All or several of the teeth are provided near the front free end with a pivoted spring-retracted finger which is adapted to take into the hay and hold it on the teeth of the stacker frame while the latter is being operated for dumping the hay on the stack.

Of General Interest.

GAFF.—W. F. WERLINE, Denison, Texas. This invention has reference more particularly to a device which comprises relatively movable jaws for seizing the fish or animal, and adapted to be set in open positions, and means tending to hold the jaws closed, and to close the same when the jaws are open, the jaws when set holding the means inoperative, whereby the jaws themselves can be actuated to release them from their open positions and to render the closing means operative.

KNOCKDOWN SHOW CASE.—L. N. LEVINSOHN, New York, N. Y. This case is designed for use in stores and other places for containing handkerchiefs and other merchandise, and for displaying the same to the best advantage, the case being simple and arranged to permit convenient assembling of the parts or their disassembling to allow packing the same into a small bundle for transportation or storage.

SPEED GAGE.—O. EVENSEN, Montreal, Canada. This gage is one more particularly used for nautical purposes, as in determining the speed of a boat or a current. Use is made of a casing provided with a torsion spring, and indicating means controlled by the spring, together with blades pivotally mounted in the casing and adapted to be swung outwardly at right angles to the casing, the blades being adapted to have a force exerted against them, the speed of which is indicated by indicating means.

REVETMENT MATTRESS.—C. C. CONDIE, Memphis, Tenn. The present invention provides means for reinforcing and strengthening the mattress in such manner as to prevent tearing of the covers employed for retaining the concrete mass, together with means for facilitating the unrolling of a mattress when wound in roll form and also means for anchoring a revetment mattress on a bank to overcome the tendency to slip down the bank of a river in its use of the mattress.

FOUNTAIN PEN.—M. S. OLSEN, Harvey, N. D. This fountain pen has a convenient and simple means for filling in a rapid manner. It is absolutely non-leakable when carried in the pocket, and the flow of ink may be readily started. The flow of ink is also adjustable to suit the requirements of the user.

Hardware and Tools.

SEAL FOR FAUCETS.—C. C. HUCKE, St. Joseph, Mo. This invention is for use in preventing unauthorized persons from tapping a barrel or keg while in transit. Use is made of a seal or lock covering, the faucet entrance opening and having means for holding the seal against turning in the faucet, and means for preventing the seal from being lifted out of the faucet after once being placed in position therein.

Household Utilities.

LIQUID FUEL STOVE OR HEATER.—G. P. WOLFF, Bloomville, Ohio. The object here is to produce a heater for liquid fuel such as coal oil, alcohol, and similar hydrocarbons, which will be portable, and which can be readily adapted to throw the heat developed immediately into the room in which the heater is located, or arranged to distribute the heat into the rooms or apartments.

GARBAGE CLOSET.—CORNELIA S. ROBINSON, New York, N. Y. In this case the invention has reference to garbage closets, and it has for its object to provide one with means by which a plate, normally disposed in a receptacle, may be moved forwardly by the opening of the receptacle door, so that a garbage pail, disposed on a plate, is accessible.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

LEGAL NOTICES

PATENTS

INVENTORS are invited to communicate with **Munn & Co., 361 Broadway, New York,** or **625 F Street, Washington, D. C.,** in regard to securing valid patent protection for their **inventions. Trade-Marks** and **Copyrights** registered. **Design Patents** and **Foreign Patents** secured.

A Free Opinion as to the probable patentability of an invention will be readily given to any inventor furnishing us with a model or sketch and a brief description of the device in question. All communications are strictly confidential. Our **Hand-Book** on Patents will be sent free on request.

Ours is the **Oldest** agency for securing patents; it was established over sixty-five years ago.

MUNN & CO., 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance. Further information sent on request.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. **In every case it is necessary to give the number of the inquiry.** Where manufacturers do not respond promptly the inquiry may be repeated.

MUNN & CO., Inc.

BUSINESS OPPORTUNITIES.

FOR INVESTORS.—I have invented a switchboard and rack for Telephone Exchanges. Radical improvement. Greatly reduces labor; increases efficiency. Want Capital to manufacture, or will sell rights at reasonable figure. W. C. Smith, 842 Central Building, Seattle, Wash.

CAPITAL OR PARTNER WANTED to build a working model, rotary metal wing flying machine. Patent No. 986120. Will personally supervise the building of the machine. J. H. Buss, Dundee, Ohio.

A NEW ENGLAND COMPANY, employing 1,000 hands, with modern equipment for doing high grade mechanical work, desires some new lines to manufacture. Will buy meritorious article outright or make on royalty basis. Mechanical, Box 773, New York.

FOR SALE.

OUTRIGHT SALE OR ON ROYALTY.—U. S. Patent No. 986790. Canadian Patent No. 125911. Safety Envelope. Special flap construction, upon sealing it being impossible to gain access without leaving evidence envelope has been tampered with. For particulars address Neil Macdonald, Irish Cove, Nova Scotia.

WANTED.

LOCAL REPRESENTATIVE WANTED. Splendid income assured right man to act as our representative after learning our business thoroughly by mail. Former experience unnecessary. All we require is honesty, ability, ambition and willingness to learn a lucrative business. No soliciting or traveling. This is an exceptional opportunity for a man in your section to get into a big paying business without capital and become independent for life. Write at once for full particulars. Address E. R. Mardea, Pres. The National Co-Operative Real Estate Company, L., 378 Marden Bldg., Washington, D.C.

MISCELLANEOUS.

THE DEAF HEAR instantly and clearly with the Acousticon. You must hear before your purchase. Special instruments universally used in Churches and Theatres. Booklet free. General Acoustic Co., 207 Beaufort Street, Jamaica, New York City.

LEARN TO FLY. $1,000.000 IN PRIZES.—Correspondence course in aviation. University Extension Bureau, Aviation Department, Chicago.

LISTS OF MANUFACTURERS.

COMPLETE LISTS of manufacturers in all lines supplied at short notice at moderate rates. Small and special lists compiled to order at various prices. Estimates should be obtained in advance. Address Munn & Co., Inc., List Department, Box 773, New York.

INQUIRY COLUMN

Inquiry No. 9217.—Wanted, the names and addresses of manufacturers of machinery for shelling almonds and peanuts.

Inquiry No. 9218.—Wanted, the names and addresses of manufacturers of outfits for salting almonds and peanuts.

Inquiry No. 9223.—Wanted, to buy machinery for making sugar of milk.

Inquiry No. 9224.—Wanted, to buy a motor driven floor scrubbing machine.

Inquiry No. 9225.—Wanted, a concern able to grind and polish hammers.

Inquiry No. 9226.—Wanted, to buy a machine for making flat-sided popcorn cakes.

Inquiry No. 9227.—Wanted, a power-driven saw for cutting down pine trees twenty inches in diameter.

Inquiry No. 9228.—Wanted, to buy fabric tufting machines.

Inquiry No. 9229.—Wanted, addresses of manufacturers of an alloy called Duraluminum.

Inquiry No. 9230.—Wanted, to buy a plant for the manufacture of alcohol and sawdust

Inquiry No. 9231.—Wanted, addresses of owners of water falls having a four-foot fall and upwards.

Inquiry No. 9232.—Wanted, addresses of manufacturers of engines that can be run with crude oil.

Inquiry No. 9233. Wanted, a roller or other device for skinning a beef in rapid, economical manner.

Inquiry No 9234. Wanted a small specialty of universal salability to sell from $3 to $10. Proper articles can be financed.

Inquiry No. 9235.—Wanted, names and addresses of manufacturers of machinery and appliances for making celluloid.

Inquiry No. 9236.—Wanted, the name and address of the firm making the New England Filling Machine.

Inquiry No. 9237.—Wanted, information relative to the Parmelee Automatic Aerated Water Still and Sterilizer.

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12377) C. H. G. says: What is an *ecuelle*? A. An *ecuelle* is an instrument for

rupturing the oil vessels of citrus fruits. Its construction will be seen by the annexed engraving. Short spines serve to rupture the oil vessels, and a shallow trough serves to carry away the oil gathered.

(12378) C. H. D. asks: Will you kindly tell me if there is any difference between sun and standard time in Washington, D. C., or if they are both the same time? If there is a difference, how many minutes? A. Eastern standard time is that of the 75th meridian west of Greenwich, or five hours earlier than Greenwich time. The city of Washington, D. C., is 5 hours, 8 minutes, and about 11 seconds west of Greenwich. There is therefore a difference of 8 minutes and 11 seconds between Eastern standard time and Washington time.

(12379) C. J. J. asks: Can you give me some idea of how many pounds a log 12 inches by 12 inches, 25 feet long, will hold up in fresh water afloat? A. The timber contains 25 cubic feet, should weigh 1,000 pounds, and displace an equal weight of water. If loaded to the sinking point, the log would displace 25 cubic feet of water, weighing 1,562 pounds, so that you could support a weight of 562 pounds on top of the log. Naturally the log would soon soak up water and increase in weight, and you could not load the log so that it was fully submerged; so that practically you could not support 560 pounds, as calculated.

(12380) A. W. F. writes: A certain little sensational magazine has a piece about the "dark day," May 19th, 1780, and makes a quotation (?) from Herschel the astronomer as follows: "The dark day in North America was one of those wonderful phenomena of nature which will always be read with interest, but which philosophy is at a loss to explain." A. We have nothing about "dark days" except what has come down concerning them. By comparison with such days as we have at present, it would seem that the accounts must have been overdrawn. Our dark days are caused by a low barometer with a high humidity, and much dust or soft coal smoke in the air. The result is that the cloud which is formed is much denser than clouds usually are, and the midday is so dark that lights must be burned. Such days are seen almost every year in the eastern part of our country. In London, England, the same circumstances produce a "London fog," so deep that one cannot see across the street, and lights are lit everywhere. Still the air is not damp. It is not a wet fog, such as comes at evening in the summer or in a storm. The story which you quote is no wilder than some of the stories we read in our daily press.

(12381) T. F. P. says: Will you kindly tell me what metal, or combination of metals, expands and contracts the most by raising and lowering the temperature of same? I want to use a metal rod about 3/16 inch diameter by 4 inches long, and want a metal that will expand and contract about 1/8 or 3/16 inch by increasing the temperature from normal to a dull red heat. The metal must be durable, but not expensive. A. The coefficient of expansion of cadmium is 0.000031, that of zinc and lead is 0.000029. These are the largest among the metals. The temperature of red heat is about 400 deg. C. This is the melting point of zinc, while cadmium and lead melt at 315 deg. and 322 deg. respectively. If these metals be heated to 400 deg. C., it will require a rod 10 inches long to expand one-eighth of an inch. There is no metallic substance which will expand as much as you wish to obtain.

(12382) C. S. S. says: If convenient, I would like to receive the table on expansion of mercury or quicksilver. A. The coefficient of the cubical expansion of mercury between the temperatures 24 deg. C. and 300 deg. C. as given in the Smithsonian Institution Tables, is 0.0001818.

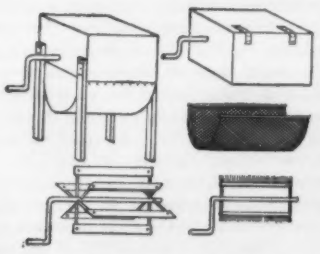
(12383) C. L. B. says: In the SCIENTIFIC AMERICAN of June 18th, 1910, I saw your statement that if a belt fitting exactly to the earth, 25,000 miles long, was lengthened 18 feet, it would stand out from the earth's surface about 3 feet. I have worked this thing out and get a different answer. I worked it as follows: Diameter of the belt before lengthened is $\frac{132,000,000}{3.14159} = 42,016,940.46645$ feet. The diameter of the belt lengthened 18 feet is $\frac{132,000,018}{3.14159} = 42,016,946.19603$ feet. I subtracted the numbers and got 5.72958, and divided by 2, which gave me 2.86479 feet that the belt stands from the earth. Your answer differs from mine to about 0.4 of a foot. I will be obliged if you will send me all the figures of your work. A. We are glad to receive your calculation for the effect of lengthening the circumference of the earth by 18 feet. It will not be necessary to send you any other calculation, as yours agrees sufficiently with ours. We said the belt would stand off about 3 feet from the earth, and you obtain 2.86 feet, which is about 3 feet. It differs by less than 1½ inches in the diameter of a circle whose diameter is about 7,918 miles. This quantity is so small that it could not be seen if two such circles were before you at such a distance that you could see the whole of them. We cannot carry such calculations to a fraction of an inch. The radius of the earth at the equator is now taken to be 3,963.296 miles, and at the poles is 3,949.790 miles. These are the values found by Col. Clark in his computations of 1878. If you use these numbers, you will obtain slightly different results; they go to 1000th of a mile, and 1000th of a mile is more than 5 feet.

(12384) A. J. M. asks for a table of decimal equivalents. A. Table of Decimal Equivalents.—Of 8ths, 16ths, 32ds and 64ths of an inch:

1/64 = .015625	23/64 = .34375	43/64 = .671875
1/32 = .03125	11/32 = .359375	22/32 = .6875
3/64 = .046875	23/64 = .375	43/64 = .703125
1/16 = .0625	12/32 = .390625	44/64 = .71875
5/64 = .078125	13/32 = .40625	45/64 = .734375
3/32 = .09375	27/64 = .421875	24/32 = .75
7/64 = .109375	7/16 = .4375	47/64 = .765625
4/32 = .125	29/64 = .453125	25/32 = .78125
9/64 = .140625	15/32 = .46875	49/64 = .796875
5/32 = .15625	31/64 = .484375	26/32 = .8125
11/64 = .171875	16/32 = .50	51/64 = .828125
6/32 = .1875	33/64 = .515625	27/32 = .84375
13/64 = .203125	17/32 = .53125	53/64 = .859375
7/32 = .21875	35/64 = .546875	28/32 = .875
15/64 = .234375	18/32 = .5625	57/64 = .890625
8/32 = .25	37/64 = .578125	29/32 = .90625
17/64 = .265625	19/32 = .59375	59/64 = .921875
9/32 = .28125	39/64 = .609375	30/32 = .9375
19/64 = .296875	20/32 = .625	61/64 = .953125
10/32 = .3125	41/64 = .640625	31/32 = .96875
21/64 = .328125	21/32 = .65625	63/64 = .984375

(12385) H. H. asks: We have a radiator full of cold water with an expansion tank 10 feet above it. We heat the water in the radiator to 180 deg. and force water out of the radiator into the tank, then when the water cools off in the radiator, will there be an air space in it, or will the tank fill the radiator up full? A. The dissolved air in the water will be driven off the first time the water is heated in the heater, and will escape, if the system is well designed, through the expansion tank. After the radiators are once vented and filled with hot water, no air can get into them, and the contraction of the water in cooling will be taken up by the lowering of the surface of the water in the expansion tank.

(12386) A. C. L. asks how to make a sieve. A. The construction of a home-made sieve will be readily understood by reference to the engraving. Sheet iron or tin and wood may be used. Wire screening of the proper fineness should be employed. The mixing arms may be



of wire. Another mixer provided with brushes serves to mix and sift certain materials. Bolting cloth is used for very fine sifting, but is expensive.

(12387) R. D. G. says: Will you kindly inform me as to what method is used in determining the safe carrying capacity of insulated electrical conductors, as well as the standard for the same, as adopted by the American Institute of Electrical Engineers? A. By "safe carrying capacity" for wires as used in the Rules of the Board of Fire Underwriters is signified that current which an insulated wire may carry indefinitely without becoming too hot to be held by the hand or damaging the insulation. It is far below what a wire can carry if bare and in the open air.

When—

Clearing Land of Stumps and Boulders

Felling Trees, Splitting Logs

Grading Roads, Digging Ditches

Planting and Cultivating Fruit Trees

Breaking Hard Pan, Sinking Wells

Excavating Cellars and Foundation Trenches

Trenching for Tile and Pipe Lines

Digging Holes for Poles and Posts

USE

DU PONT

RED CROSS

LOW FREEZING DYNAMITE

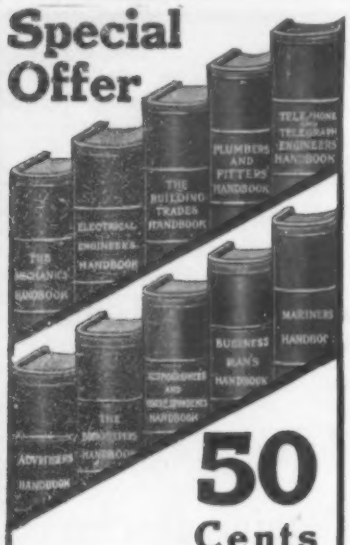
The Result of a Thorough and Extensive Study of Farm Requirements

Write for FARMER'S HANDBOOK—*no charge*

E. I. du Pont de Nemours Powder Company

Established 1802 *WILMINGTON, DEL., U. S. A.*

Special Offer



50 Cents

No books in existence contain in the same space so much knowledge about the different trades and professions as do the I. C. S. Handbooks. They are compiled from the Courses of the International Correspondence Schools, of Scranton, Pa., which have been written by the best experts in the country. These little books are, therefore, consulting experts of the highest rank—pocket memoranda of inestimable value to the executive, foremen, and managers. They are invaluable as promotion gainers for ambitious men in subordinate positions, because they can be easily understood without a knowledge of higher mathematics, and contain just the information needed by men to secure promotion.

SPECIAL OFFER.—For a limited time we are selling these Handbooks, durably bound in cloth, with gilt titles, containing on an average of 375 pages and 175 illustrations, regularly sold for $1.25, at a price for each Handbook of 50c

Send the coupon NOW

International Textbook Company
Box 942-P, Scranton, Pa.

I enclose $ _____ for which please send me the Handbooks before which I have marked X.

___ Mechanics'	___ Advertiser's
___ Electrical Engineer's	___ Bookkeeper's
___ Building Trades	___ Steno. and Corr.
___ Plumbers and Fitters'	___ Business Man's
___ Tel. and Telegraph	___ Mariners'

Name _____

St. & No. _____

City _____ State _____

Incorporate Your PATENTS and BUSINESS in ARIZONA

Laws the most liberal. Expense the least. Hold meetings, transact business anywhere. Blanks, By-Laws and forms for making stock full-paid for cash, property or services, free. President Stoddard, FORMER SECRETARY OF ARIZONA, resident agent for many thousand companies. Reference: Any bank in Arizona

STODDARD INCORPORATING COMPANY, Box 8000 PHOENIX, ARIZONA

SUCCESS SHORTHAND

is written by Clyde H. Marshall, world's champion shorthand writer, and is taught in good schools everywhere. Learn Success Shorthand at your nearest school or by mail from us. For beginners and stenographers. Catalogue free.

SUCCESS SHORTHAND SCHOOL
Suite 405, 79 Clark St., Chicago

Learn Watchmaking

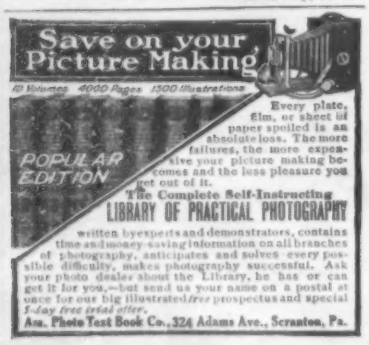
We teach it thoroughly in as many months as it formerly took years. Does away with tedious apprenticeship. Money earned while studying. Positions secured. Easy terms. Send for catalog.

ST. LOUIS WATCHMAKING SCHOOL, St. Louis, Mo.

PUBLIC SALE

Manufacturing Plant, business, equipment, and good will of undersigned company will be sold at auction sale on March 4th, 1911, at 10 A. M., at factory in Iowa City, Iowa. Also all materials and stock on hand. Present manufacturers of Gasoline Engines, Feed Grinders, Grain Elevators and Pumping Jacks. Switch connections to main line of Rock Island Ry. City Street Car line to factory. For further particulars, address

THE O. S. KELLY WESTERN MFG. CO.,
Iowa City, Iowa.



Every plate, film, or sheet of paper spoiled is an absolute loss. The more failures, the more expensive your picture making becomes and the less pleasure you get out of it.

The Complete Self-Instructing LIBRARY OF PRACTICAL PHOTOGRAPHY

written by experts and demonstrators, contains time and money-saving information on all branches of photography, anticipates and solves every possible difficulty, makes photography successful. Ask your photo dealer about the Library, he has or can get it for you,—but send us your name on a postal at once for our big illustrated *free* prospectus and special 5-day free trial offer.

Am. Photo Text Book Co., 324 Adams Ave., Scranton, Pa.

Longer Piers for the Port of New York

(*Continued from page 158.*)

that the city of New York seeks no extension which will be unfair to New Jersey interests, and asks that the establishment of the pierhead lines on both sides of the river shall now be given consideration.

As regards the third objection, I would respectfully submit the following points:

1. The fairway opposite the Chelsea district is now 2,750 feet wide between pierhead lines. The extension asked for will reduce this to 2,650 feet, a width greatly in excess of that of the fairway at other important ports; thus, at Antwerp abreast the port the river is 2,000 feet wide, and in some turns of the river only 1,000; at Hamburg the river is 1,200 feet wide, and at Rotterdam 1,200; at Liverpool, 2,000 to 2,400; the Thames at the Tilbury Docks is approximately 1,600 feet wide, and at London, in some parts of the London docks, where large steamers continually go, the width of the river is reduced to 600 feet. It is also to be noted that the Hudson fairway is nearly straight in comparison with the tortuous channels existing at many of the ports noted.

2. Sailing vessels, river boats and lighters have almost disappeared from the harbor waters. Traffic is now generally moved under steam, and is consequently under better control than formerly.

3. Twin screw steamers of modern construction can turn and maneuver in much shorter distances than heretofore.

4. If need be, the movement of traffic can be placed under greater police restriction that at present; although this does not now seem necessary.

5. The Ambrose channel has been dug at great expense by the Federal authorities and should be availed of to bring vessels of a length proportionate to their draught to Manhattan.

6. The Panama Canal locks are being constructed for vessels 1,000 feet in length, and accommodations for this class of vessels should be provided.

7. In the Chelsea district it will be impracticable to secure greater pier lengths by excavation inshore on account of the prohibitive cost of such undertaking, and the fact that a marginal elevated freight railway is being planned, the alignment of which will be prejudiced by the sharp turns made necessary by such a radical change in the city street plan. Again, the city has just finished the construction of the new Chelsea piers, the finest and largest of their kind in the world, at a cost of about $24,000,000, and any rearrangement at this time will be most unfortunate.

8. The steamship companies occupying the Chelsea piers have leased them for long periods of time, and the city cannot relieve them from these engagements without serious disarrangement to its finances, since it is depending upon the capitalization value of revenues derived from leases for additional waterfront improvements.

9. I would venture the suggestion, subject to the opinion of the New Jersey authorities, that an extension of the pierhead line of Castle Point, opposite the Chelsea district, is not urgent or desirable, since it is the jutting point of the New Jersey shore and better opportunities for extension exist both above and below that point.

10. A slight turn in the river at this point tends to deflect the lines of traffic both up and down stream toward the New Jersey and away from the Manhattan shore.

11. The Department of Docks has prepared and will soon submit its report for a better system of railroad terminals for the west side of Manhattan. In a general way this report recommends that the present system of daily storage of car float terminals along the river front be so changed that railroad cars shall be loaded and unloaded at terminals on the east side of the marginal way, thus restoring the waterfront to marine commerce. If the policy recommended is to be adopted, it will ultimately be possible to build long piers for long ships at many points, which will be to the advantage of the port's commerce. The greatest sea port of the world should be able to berth the greatest ships to their and its greatest advantage.

I submit herewith:

(a) Cross section of the river opposite the Chelsea piers as modified by inshore excavations on the Manhattan side.

(b) Sketch showing additional length of piers in this vincity.

(c) General plan of proposed pierhead line extension along the west side of Manhattan from the Battery to 99th Street.

(d) Sketch of Cunard and White Star piers in the Chelsea district, together with models of steamers "Baltic," "Olympic," and of proposed new Cunard ship.

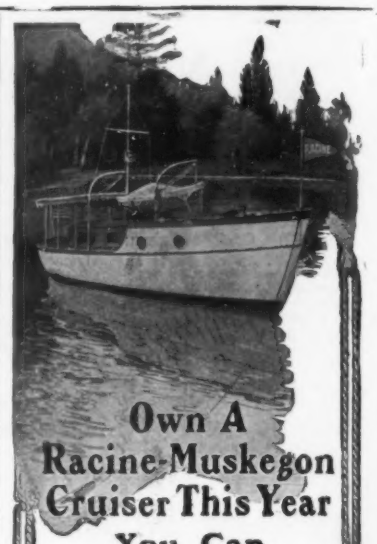
In conclusion, I will again state that New York city submits no partisan plea and desires to reach a decision which shall be fair for New Jersey as for New York interests, and which shall not prejudice the future utility of its harbor.

Creating New Kinds of Animals and Plants

(*Continued from page 165.*)

from the Little Club was used on stigmas from the Valley. The right half of the picture shows the results when pollen was used from Valley on the stigmas of the Little Club. In each case the results are seen to be the same. The three short heads shown at the extreme left of the picture are three first generation hybrids. It is seen that they are all alike and very much like the Little Club. To the right of each of these three heads are seen the six types, which could be distinguished by inspection, produced by each of these first generation hybrids. One type is seen to be long and bearded; another long and beardless; another of intermediate length and bearded; a fourth of intermediate length without beards; the fifth bearded Club, and the sixth beardless Club. The two intermediate lengths are hybrids between long and short heads. The same types are seen to appear in every case in the second generation. For instance, in the cross between Valley and Little Club there were some plants with lax bearded heads, other plants had lax beardless heads, others bearded Club heads, while still others had beardless Club heads. It was found later that some of all these types were winter wheat, some spring wheat, and some hybrid between winter and spring wheat. In every one of the crosses made, the combination of good characters sought for actually occurred, and several new varieties of wheat were produced which combined the winter hardiness of the winter wheats with the stiff straw and the tightly closed chaff of the spring wheat. In due time the pure types of the kind desired were selected out of these hybrids, tested for yielding power, and finally, in the fall of 1907, distributed to the farmers of eastern Washington. These hardy hybrid wheats are now grown very generally in that region and are producing yields very much larger than the old Little Club produced. Not only that, but the quality of the grain is better, and the hybrid wheats sell for two or three cents a bushel more than the old Club wheat.

I have already referred to the fact that a new breed of cattle has been produced by the deliberate application of Mendel's law of recombination. Fig. 5 is a picture of a very fine animal produced in this way. Originally the Polled Durham was crossed with the Hereford. After several generations pure polled cattle were produced that had the red color and the white face of the Hereford breed, and a registry associa-



Own A Racine-Muskegon Cruiser This Year

You Can Afford It

FIFTY boat wise people were made glad last year with the ownership of the marvelous **36-ft. raised-deck Racine Cruiser.** Four times that number were disappointed—they came too late. We can build only a like number of these beautiful boats this year—just fifty, that's all. 36 feet over all she measures,—her beam is 8 ft. 6 in. She will go anywhere there is two feet six inches of water, and you can take your friends on this boat with cruising accomodations for eight; toilet room, folding lavatory and mirror, owner's stateroom, and cockpit holding ten. The galley is big, fresh water tanks for salt water cruising, ice box, sink, surplus storage and all—a real home on water, independent of all the hotels on earth.

Save $2,500 On This Boat

And the price—other builders with limited capacity and old fashioned methods would have to ask $3,500 to about $5,000 but our price is $2,400 for the whole outfit! Every detail of hull and fittings is up to the regular Racine standard, nothing scrimped, no pains of labor or material spared just to make the price low.

Everything that goes with a boat is included, dinghy and davits, lights, screens, standing top, cushions, curtains, flags, signal mast and fittings, power whistle, fog bell, life preservers, boat hook, stove, removable table, etc. Powerful motor of the latest type four cylinder, 4-cycle, self-starting—developing 25 to 30 H. P.—with double ignition system, including gear driven magneto, *all so simple that even a novice will have no trouble.* Complete electric light plant with dynamo. Sounds like a marine catalogue, doesn't it? You will find no extras to buy on this boat.

You can afford to own this boat and run it yourself. You will require no crew. It's a "one man boat" in the sense that you can handle it all by yourself, if you wish, and go anywhere.

We will gladly tell you about this newest member of the Racine family as well as the other boats we make. Send today for the story of "The Cruise of the Bonita," which will help you select the boat you need.

Racine Boat Mfg. Co.
Dept. 12 Muskegon, Mich

Member—National Boat and Engine Company

Salesrooms—Chicago Buffalo Detroit New York Boston Philadelphia Seattle

4 H.P. STATIONARY GASOLINE ENGINE COMPLETE $76.00

For Farmwork, Irrigation or Pumping, Factory use and Electric Lighting.

3 to 20 h. p.—perfectly governed-guaranteed by a responsible firm. Write for particulars.

GRAY MOTOR CO. 121 Leib St., DETROIT, MICH.

Kerosene Oil Engines

Marine, Stationary, Portable

NO DANGER. Maximum Power, Lightest Weight, Simple, Reliable, Economical. No Batteries, Self Ignition by Compression. Fully guaranteed. Write for Catalogue S. A. No charge for packing.

AMERICAN OIL ENGINE CO.
DANIELSON, CONNECTICUT

Use KEROSENE Engine FREE!

Amazing "DETROIT" Kerosene Engine shipped on 15 days' FREE Trial, proves **kerosene** cheapest, safest, most powerful fuel. If **satisfied,** pay lowest price ever given on reliable farm engine; if **not,** pay nothing.

Gasoline Going Up!

Automobile owners are burning up so much gasoline that the world's supply is running short. Gasoline is 9c to 15c higher than coal oil. Still going up. **Two** pints coal oil do work of **three** pints gasoline. No waste, no evaporation, no explosion from coal oil.

Amazing "DETROIT"

Only $45.00 and up. The "DETROIT" is the **only** engine that handles **coal oil** successfully; uses alcohol, gasoline and benzine, too. Starts without cranking. Basic patent—only three moving parts—no cams—no sprockets—no gears—no valves—the utmost in simplicity, power and strength. Mounted on skids. All sizes, 2 to 20 h.p., in stock ready to ship. Engine tested just before crating. Comes all ready to run. Pumps, saws, threshes, churns, separates milk, grinds feed, shells corn, runs home electric-lighting plant.

Sent any place on 15 days' Free Trial. Don't buy an engine till you investigate amazing, money-saving, power-saving **"DETROIT."** Thousands in use. Costs only postal to find out. If you are first in your neighborhood to write, we will allow you **Special Extra-Low Introductory** price. Write!

Detroit Engine Works, 127 Bellevue Ave., Detroit, Mich.

PENNSYLVANIA RAILROAD

Reminder Bulletin

A BOON TO THE BUSY MAN

The use of the most modern type of speed-making locomotives, coupled up to the best type of equipment and guided by the most vigilant management makes railroad travel secure and prompt.

The time of a busy man is one of his assets. It means either gain or loss to him.

The certainty of figuring his time in transit to the exact hour relieves his engagement list from entanglement.

The telephone may make the engagement, the train will keep it.

The ***Pennsylvania Special*** follows up the telephone message. It brings the two ends of the wire together and consummates the meeting between working hours.

The man with business connections in New York and Chicago can lose no time by traveling on the ***Pennsylvania Special.*** It runs while the desks are closed.

Pennsylvania Special (17 hours and 55 minutes between New York and Chicago) leaves Pennsylvania Station, New York, 4.00 p. m., Downtown tube, 3.55 p. m. and arrives in Chicago 8.55 a. m.

Over five hours for business to 2.45 p. m. when it leaves Chicago for the East and arrives in New York next morning (breakfast on the train) at 9.40 a. m.

A PULL TURNS ON THE SUNLIGHT

Better than electricity or city gas, cheaper than kerosene or candles. Steady, white, Brilliant; 1-4c per hour. Burns 97 per cent air. Lighted or extinguished by pull of chain. No smoke, no soot, no odor, no grease, no wicks to trim. **Helios Light** Absolutely Safe

For homes, stores, halls, factories, shops, churches, hotels, public buildings, streets. Delivered ready for anyone to install. Write now for free booklet and make selection from our numerous artistic styles. Exclusive territory and big money for good agents. We help you sell.

Standard-Gillett Light Co., 9 H Michigan St., Chicago, U.S.A. Established 1895. Paid-in Capital $150,000.00

Magical Apparatus.

Grand Book Catalogue. Over 700 engravings 25c. Parlor Tricks Catalogue, free.

MARTINKA & CO., Mfrs., 66 Sixth Ave., New York

TYPEWRITERS ALL MAKES

Visible Writers or otherwise

Olivers, Remingtons, Smiths, etc.

Shipped ANYWHERE for Free Trial, or RENTED, allowing RENT to APPLY.

Prices $15.00 up

First class Machines *fresh from the Manufacturers*

Write for Illustrated Catalog 10. *Your opportunity.*

TYPEWRITER EMPORIUM (Est. 1892), 92-94 Lake St., Chicago.

This Fastener for YOU

100 in a box, 15c

Two Points, and two lips, hold top, bottom and middle papers with equal security.

The De Long Hook and Eye Company, Philadelphia

Samples—five sizes—free on request.

Twin Grip PAPER FASTENERS

The lead pencil of economy, cleanliness and quality

The BLAISDELL Paper Pencil

Every grade of lead for every purpose, for school, newspaper work, photography, etc.

Price, one to ten cents each, everywhere.

Any Two Pencils Sent Postpaid

Two *best quality* pencils mailed on receipt of ten cents. Offer includes colored crayon pencils for marking, etc. State for purpose used or color.

THE BLAISDELL PAPER PENCIL CO., 4411 Wayne Ave., Philadelphia, Pa.

A BOON TO THE BUSY MAN

tion—in fact, two of them—has been started for registering Polled Herefords. I have already stated that it is not always possible, by inspection, to distinguish between an animal which is a pure poll and one which is a hybrid between the polled and the horned. Frequently the hybrids have no sign of a horn.

But there is a way of distinguishing these hybrids from pure polls, especially in the case of the males. It is as follows: Breed the male to a dozen horned cows. If he is hybrid, the chances are that he will transmit the horns to half his offspring. These, receiving horns from the dam also, will be pure horned animals. If, however, the animal is pure polled, he will transmit the poll character to all his progeny, but since the hybrid between the polled and horned never has perfect horns, none of these calves will have perfect horns, no matter what his dam is. But since it is an even chance whether a hybrid of this kind will transmit horns or the poll character to a given offspring, it is possible that a hybrid might get twelve polled calves from twelve horned cows. The chance, however, that this will occur is only one in more than four thousand cases. Hence a breeder who has thus tested a young bull is safe in guaranteeing that none of his calves will have perfect horns, no matter what the dam may be. He will have to make good this guaranteed once in 4,096 times. Breeders of Polled Herefords now frequently test young bulls in the manner above described, then sell them at high prices under a guarantee that all their calves will be polls, or at least have only scurs.

It is a comparatively easy matter to produce any desired breed of animals or any desired variety of plants when the various characters desired can be found scattered in breeds or varieties that can be cross bred. Application of these principles in producing new breeds and varieties have thus far not been very numerous because the principles are new, but they are being used now more largely than in the past, and will undoubtedly play an important part in the improvements of farm crops and farm animals in the future. In fact, the same principles can be applied in improving the human race, and they are now being applied in a rough way in several States.

VIGOR OF HYBRIDS.

Another important principle which is frequently made use of by farmers is the fact that generally speaking hybrids are more vigorous than pure-bred plants or animals. Fig. 2 is a photograph of some steers which are hybrids between Short Horns and Herefords. They have the characteristics white face of the Hereford, but the spots of red in the face show the hybrid origin. Mr. Wallace Huidekoper, of North Dakota, who furnished this photograph, produces many such hybrids for feeding purposes, and states that they feed better and make better beef animals than the pure breds. This principle is frequently applied by hog breeders to produce feeders; but on account of the law of recombination of characters, these hybrid animals do not reproduce true to type and hence are not good for breeding purposes.

Our knowledge of the law of recombination enables us to get rid of undesirable characters which occasionally crop out in breeds of animals. For instance, in all of the polled (that is, hornless) breeds occasionally horned individuals are born. We know now that this can occur only when both of the parents of the horned calf are hybrid with reference to horns. This shows that there is still, in all these breeds, a small percentage of animals that have horns latent in them. When two such animals are mated the chances are that one-fourth of the calves will be horned. Knowing the cause of the appearance of horns in these breeds, we are in position to avoid them by eliminating both the sire and the dam of such calves whenever they occur. In this way the proportion of horned calves born in the polled breeds is gradually decreasing, until now they are very rare indeed in some breeds.

In all black breeds of cattle there are occasionally red calves born. This is due to the fact that there is, in such breeds, a small percentage of animals that are hybrid between red and black. When these are mated, one-fourth of the calves are red. The undesirable red can be eliminated from the breed only by destroying both the sire and the dam of every red calf born.

Dr. Pearl, of the Maine Experiment Station, has recently shown that high egg-laying capacity in hens is transmitted as a Mendelian character. This is a matter of very great importance, and will undoubtedly result in great improvement in all of our breeds of chickens.

Another interesting application of Mendelian principles is seen in the cross between Brahmin cattle and our common cattle which is being made on a large scale in our Southern States, especially Texas. Fig. 1 is the photograph of a Brahmin bull owned by the Georgia Experiment Station. The most important characteristic of these cattle is the fact that the Texas fever tick does not molest them. This immunity from the tick, and consequently from Texas fever, is a dominant character, so that the hybrids between Brahmin cattle and our common cattle are immune to Texas fever.

Mr. A. P. Borden, who is one of the prominent breeders of these hybrid cattle, informs the writer that because of this immunity from ticks the calves of this breed are much larger at weaning time than our ordinary calves, and sell regularly for fifty per cent more on account of their size and thrift. Mr. Borden recently imported from India a large number of these Brahmin cattle, and several breeders are now engaged in distributing this blood among southern cattle.

Fig. 7 illustrates a mistake that breeders of animals sometimes make. This shows a pig of the Hampshire breed, which has a white stripe over its sounders. This white stripe is an exceedingly variable character, and it is exceedingly difficult to breed these pigs true to type. This white marking is a character which has no economic value, and in order to breed it pure it is necessary sometimes to use animals for breeding purpose that are not of good quality.

Fig. 4 shows a similar mistake with a breed of cattle. It will be noticed that this animal has a white stripe over the hips and another just behind the shoulders. A few breeders insist that their cattle shall have these white stripes. They are of no economic value, and the attempt to establish such a character is certain to react on the economic value of the breed.

Fig. 9 shows a sample of what is known as hogget wool. This sample was taken from one of two fleeces found in a large quantity of wool bought by a country buyer in Michigan. It sold for ninety cents a pound, while the other fleeces sold for about twenty cents. The pecular wavy character of this sample is the characteristic which makes it so valuable. We have not yet been able to locate the herd of sheep from which this sample came. If we could locate it, and the waviness of the wool should prove to be a Mendelian character, it would be a very easy matter to spread it over any or all the breeds of sheep in this country, since we know now the principles which must be applied to do this.

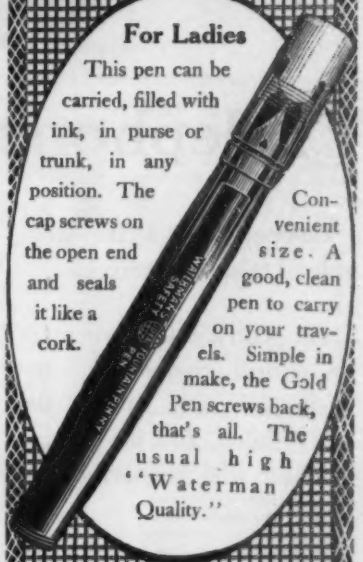
While Mendelian principles are new and have therefore not yet been widely applied, it is easily seen that there is room for enormous improvement in plants and animals by means of these scientific principles.

Waterman's Ideal Fountain Pen

Safety Pen

For Ladies

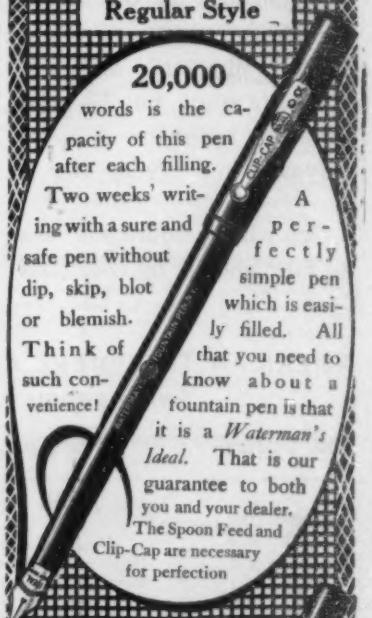
This pen can be carried, filled with ink, in purse or trunk, in any position. The cap screws on the open end and seals it like a cork.



Convenient size. A good, clean pen to carry on your travels. Simple in make, the Gold Pen screws back, that's all. The usual high "Waterman Quality."

Regular Style

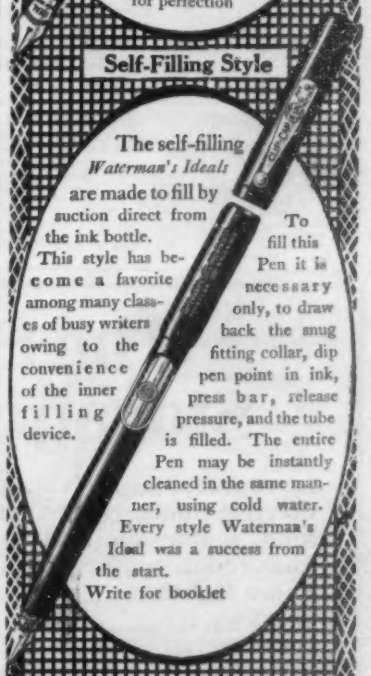
20,000 words is the capacity of this pen after each filling. Two weeks' writing with a sure and safe pen without dip, skip, blot or blemish. Think of such convenience!



A perfectly simple pen which is easily filled. All that you need to know about a fountain pen is that it is a *Waterman's Ideal.* That is our guarantee to both you and your dealer. The Spoon Feed and Clip-Cap are necessary for perfection

Self-Filling Style

The self-filling *Waterman's Ideals* are made to fill by suction direct from the ink bottle. This style has become a favorite among many classes of busy writers owing to the convenience of the inner filling device.



To fill this Pen it is necessary only, to draw back the snug fitting collar, dip pen point in ink, press bar, release pressure, and the tube is filled. The entire Pen may be instantly cleaned in the same manner, using cold water. Every style Waterman's Ideal was a success from the start. Write for booklet

Ask Your Dealer

L. E. Waterman Co.

173 Broadway, N. Y.

8 School St., Boston 17 Stockton St., San Francisco

12 Golden Lane, London 180 Clark St., Chicago

6 Rue de Hanovre, Paris; and Montreal

Telephone Etiquette

Co-operation is the keynote of telephone success.

For good service there must be perfect co-operation between the party calling, the party called, and the trained operator who connects these two.

Suggestions for the use of the telephone may be found in the directory and are worthy of study, but the principles of telephone etiquette are found in everyday life.

One who is courteous face to face should be courteous when he bridges distance by means of the telephone wire.

He will not knock at the telephone door and run away but will hold himself in readiness to speak as soon as the door is opened.

The 100,000 employees of the Bell system and the 25,000,000 telephone users constitute the great telephone democracy.

The success of the telephone democracy depends upon the ability and willingness of each individual to do his part.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

MR. HANDY-MAN'S WORK-BENCH
is not complete without
PARKER'S PRESSED METAL CLAMP
Replaces the antiquated, cumbersome, wood clamp. For mechanics, machinists, wood-workers. Made in 2½ in., 3 in., 3½ in. sizes. Prices, 25c, 35c, 45c, respectively. Mailed post-paid on receipt of price. Special reduction when ordered in quantities. Liberal discount to dealers.
JOHN L. PARKER CO. *Metal Stampings.* WORCESTER, MASS.

New Price Era For Motor Boats!
Mullins 1911 Steel Power Boats with all the style and value of noted Mullins line at very low prices. Hulls of steel give strength and long life never in old-style boats—keels metal-covered. **Mullins 1911 Steel Motor Boats 24 and 26 ft. $400 up! 16 ft.—$118 up!**
These boats *cannot sink.* Possess all leading features of richest Mullins boats—air-tight compartments, power plant under cover, One Man Control. Silent Under Water Exhaust. *Start like an automobile.* Carry more in comfort and safety. Many other styles. Send for handsome FREE catalog. Exhibit at Nat'l Motor Boat Show, N. Y., Feb. 21st—March 4th.
The W. H. MULLINS CO., 118 Franklin St., Salem, O.

The Edison Storage Battery

is rapidly superseding all other batteries for electric pleasure and commercial vehicle propulsion, motor car and motor boat ignition, yacht, houseboat, motor boat, motor car and country home lighting—

because it is the one storage battery that is *right* in principle and construction. Not merely an improvement on the lead battery, but a new and absolutely different battery whose capacity is double that of a lead battery of equal weight and whose life is many times as long.

Write us for detailed information regarding the work of the Edison Battery in the field in which you are interested and for our new catalog.

Edison Storage Battery Co., 135 Lakeside Ave., Orange, N. J.

Cement on the Farm

(*Continued from page 167.*)

and the roof are all made of concrete. In making a mushroom cellar, it should be built at least two-thirds below the level of the ground, in order to give the best results.

From a commercial standpoint, the modern farmer has found that it pays to have an automobile. Owing to the liability of fire, the old wooden barn is a poor place to store it. Concrete suggests itself as the most feasible material of which to build the garage, as aside from its being fireproof, it will not come saturated with gasoline and oil, and it is easily kept clean. The garage can be built of concrete blocks made on the farm with either a block machine or from home-made wooden molds. Built in this way, the initial cost will be low, and the maintenance charges on such a building will practically be nothing.

The floor as well as the side walls and roof should be of concrete, and a good drain should be provided in the center of the floor to carry away the wash water.

Concrete is especially advantageous for the building of structures where perfect cleanliness is desired, such as dairy buildings. Experienced dairymen state that the material of which the barn is made is of vital importance; for as a rule, this is the breeding place of germs. By using concrete this question is to a large measure solved, because a building so constructed offers no lodgment for the breeding of germs.

If the floors, stalls, troughs, etc., are also made of concrete, perfect hygienic conditions can be obtained, and the probability of securing a good germ-proof milk is made much greater. Thus the farmer who is equipped with concrete dairy buildings is far in advance of his neighbor who still holds to his old-fashioned wooden structures.

Concrete is also largely used in tree surgery. Many a good tree has been saved by filling with concrete the large cavities which have developed in its trunk, due to disease and rot. If the cavities are so large that they have weakened the trunk of the tree, steel reinforcing should be incorporated into the patch, so as to hold it better in place and to give it strength. There are numerous other small articles about the farm for which concrete can be used, such as chimney tops or caps, hothouse frames, and well curbs. It is particularly adapted to the latter use, as it prevents the accumulation of surface water and is easily kept clean.

From the instances cited above, one will see that concrete, when properly used, is a most adaptable material. But to obtain the best results, care and judgment must be exercised in its handling.

It might be well to caution the reader on closing that in building any structures, or parts of structures, the failure of which would endanger life, such as floors, roofs, side walls, large tanks, etc., it would be well to consult an engineer for information as to the requisite thickness and the proper size and location of the reinforcing steel.

New Science of the Soil

(*Continued from page 169.*)

of the air, render the nitrogen of the soil more readily available by nitrification, and increase the availability of the insoluble phosphates and potash compounds of the soil. The activities of these organisms may be controlled to a large extent by the methods employed in fertilizing and treating the soil. (See also article on "The Science of Fertilizing the Soil.)

Many years ago it was observed that treatment of vineyard soils with carbon bisulphid to destroy phylloxera, an insect preying upon the roots of the vines, produced beneficial results which could not be wholly attributed to the destruction of the phylloxera. G. E. Stone, of the Massachusetts Experiment Station, and others observed that steaming garden and greenhouse soils apparently increased the actual fertility of the soils, in addition to destroying certain enemies of plants harbored by the soils. Russell and Hutchinson, of the Rothamsted Experiment Station, found that steaming and treatment with volatile antiseptics like carbon bisulphid or toluene only partially sterilized the soil, killing certan protozoa and ameba which feed upon the beneficial ammonia-producing bacteria, but not entirely destroying the latter, which thus freed from the organisms which hold them in check grow rapidly and soon become more numerous than before, increasing the supply of ammonia, and in consequence the fertility of the soil.

As a result of such investigations as these, soil sanitation is coming to have a recognized place in agricultural practice, and various efficient methods of sterilizing, or partially sterilizing, soils are now in use for small scale operations. The Vermont Experiment Station sterlizes the soil of solid greenhouse beds in place by forcing steam under 40 to 60 pounds pressure through 3-inch drain tile placed 10 inches deep and 16 inches apart in the soil. Stone uses 2-inch gas pipe with 3/16 to ¼-inch perforations, made up 7 to 10 inches apart, in frames of any desired width and length. Some of the frames are made in sections, so that they may be extended as desired. (See Fig. 2.) "These frames are provided with headers *h*, placed transversely, which are pipes of larger diameter containing perforations, and nipples *n* are inserted at intervals which readily fit into the extension pipes *p*. In some instances the headers are placed at each end, thus forming with the extension pipes a frame composed of a series of rectangles (Fig. 2A). In this form a complete circulation of the steam can take place. In others the headers are in the middle and the extension pipes lead off into opposite directions (Fig. 2B). In the latter case the ends of the extension pipes are plugged with wood *w*, and a complete circulation of steam does not occur. The material most frequently used is iron pipe. . . .

The method generally adopted by lettuce growers in heating their soils is to place the apparatus on the surface of the bed. If the bed is 2 feet wide, then it will be most convenient to have the heating appliance about 10 feet wide and 20 to 30 feet long. This is placed midway between the edges of the bed, and the soil to the depth of one foot is dug out on either side of the appliance and thrown on top of it. This covers the heating apparatus to a depth of one foot. The steam is now turned on and the soil heated. After sufficient steaming has taken place, the pipes can be pulled out and set up ready for the next treatment. (See Fig. 3.) The soil previously treated should be covered up with some old canvas, if available, or, in fact, with anything that will retain the heat, and allowed to stand some hours, after which the top portion is shoveled back to where it was taken from. Not only is the one foot of top soil heated by this method, but the soil under which the apparatus rests is equally well done, provided too much haste is not made in removing the treated soil.

A uniform temperature of somewhat over 180 deg. F. maintained for one and a half to two hours is considered sufficient.

A soil sterilizer used by the United States Department of Agriculture and the Connecticut State Experiment Station in steaming tobacco plant beds is shown in Fig. 4. It consists essentially of a re-enforced 18-gage galvanized iron pan, 6 × 10 feet square and 6 inches deep, with a steam hose connection with an engine. The pan is inverted over the soil of the bed, pressed down close, and steam under pressure of 75 to 100 pounds

is turned in for thirty minutes.

Modern science has thus shown that the soil swarms with living organisms, some helpful, some harmful, and it has pointed out ways of controlling these organisms, and in a measure, determining the kinds that shall prevail. On a small scale, sterilization as described above, may be used; on a large scale it will be found that beneficial bacterial activity is best promoted by the conditions which every good farmer aims to secure, viz., good tilth, deep cultivation to secure thorough aeration, an abundant but not an excessive amount of water, and adequate supplies of humus, lime, and phosphates.

The Weather Bureau

(*Continued from page 176.*)

This class of instruments in which the electric discharges in the atmosphere are registered at great distances by wireless telegraphy has interesting possibilities; but, as yet, they are possibilities only.

The long and short of it is that Farmer A must continue, for some time to come, to be at the mercy of the occasional unheralded local shower, and must console himself with the reflection that the more serious visitations of the elements—the cold wave, the blizzard, the severe cyclonic storm—will rarely come his way without due notice in advance from the forecaster.

WHERE THE FORECAST SUCCEEDS.

Let us, however, turn to another part of the country, where a first cousin of Farmer A, one X, is engaged in drying fruit, and is making a tidy fortune out of it, thanks to a sunny clime and the Weather Bureau. X lives in California; somewhere in the great valleys of the interior. The summers are very hot and almost rainless. The fruit-drying season comprises the latter half of the summer and the early autumn. Generally speaking, the climate is ideal for this industry, but there was a time when the occasional shower meant ruin. That was before the scattered handful of Weather Bureau men assigned to duty in that State turned their special attention to the dual task of making accurate forecasts of rain and giving them effective distribution wherever needed.

To-day every fruit grower within reach of the buerau's forecasts depends upon them implicitly. The burden of responsibility resting upon the forecaster is enormous. He must not, on the one hand, permit a shower to take the growers by surprise, and, on the other, he must not issue a false alarm, which would put them to needless expense in taking measures to protect the fruit. The work of forecasting for the raisin makers of California has often been described, as this was the earliest application of special rain forecasting for fruit growers. Fig. 2 will perhaps serve to convey—on the principle of *ex pede Hercules*—some faint idea of the importance of this particular work. Raisin making is, however, only a part of California's vast industry of drying fruit. Apricots, for example, were dried last year to the extent of about 15,000 tons. Of dried peaches there were 25,000 tons. There were nearly 4,000 tons of figs, black and white, 40,000 tons of prunes, and a few thousand tons of apples and pears. From July to the end of October the curing of fruit is going on in one part or another of the State; and during this whole period a score of men bear the burden of watching the weather, alert for the earliest signs of the coming shower. Upon the District Forecaster at San Francisco the burden rests most heavily; but without the faithful and intelligent co-operation of every man serving under him, he could not make his work the splendid success that it is. In the forecasting of summer rains in California alone the Weather Bureau justifies its existence; renders *quid pro quo* for the million and a half dollars of its annual budget. Let us hope that our friend X expresses *his* opinion of the Bureau on paper for the enlightenment of Farmer A.

THE FROST CAMPAIGN.

To take a further illustration from California, let us see whether the little squad of weather watchers, after the nerve-racking strain of the summer campaign against rain, are able to take things easy during the winter and recuperate. Far from it. The dried fruit is safely garnered; Jupiter Pluvius has expended his ammunition in vain. But now another formidable foe enters the field—Jack Frost. At this point I cannot do better than quote from my friend Prof. Alexander McAdie—the captain of the Weather Bureau's forces in the far West—a man whose services to the nation are so well known that it would be an impertinence to dwell upon them here. Prof. McAdie says in a recent letter to the author:

"Passing to the work in connection with the oranges and lemons, especially in guarding them against the frosts of January and February, it may be said without exaggeration that the San Francisco office of the Weather Bureau has saved to the citrus fruit growers of California more money within the last five years than the annual appropriation for the entire Bureau during a period of twenty years; and we consider that our work is only a hundredth part of the work that is accomplished by the Bureau as a whole. Taken as a whole, I think the problem of the protection of the crops from frost has been one of the pieces of work that the Department of Agriculture can well be proud of. The Weather Bureau has been the leader in this work, though lately other branches of the Department have taken it up. The problem is a twofold one; first the weather man's own proper work of giving accurate warning of the frost twelve or twenty-four hours in advance, so that the grower can fill his baskets, fix his fires, or spread his covers, and thus save his oranges and lemons. Concerning this it will be enough to say that last year there was not a single failure to forecast frosts for the orange belts of California. The work was perfect so far as forecasting goes—a thing that ten years ago seemed impossible.

"Regarding the second part of the problem, namely, the devising of the best methods of protection and the study of the physics of frost formation, the work done speaks for itself."

So much has already been written concerning frost protection—by means of orchard heating, smudging, irrigation, spraying, and otherwise—that I need not enter into the subject here further than to point out that Weather Bureau men—Hammon, McAdie, Willson, Warren Smith, to mention only a few—have been leaders both in devising new methods and in disseminating information concerning them. The authoritative literature of this subject consists chiefly of publications issued officially by the Weather Bureau. The Bureau is conducting a campaign of education in this line, the value of which is simply incalculable. Here again the Bureau justifies its existence, in terms of dollars and cents, and we have something tangible to offset the loss of Farmer A's hay.

CONCERNING CRANBERRIES.

Even government bureaus have their hobbies, and just at present the Weather Bureau's is cranberries. The value of the cranberry crop—all of which is grown in the three States, Wisconsin, New Jersey, and Massachusetts—is insignificant compared with that of the great staple fruits and cereals of the country. Nevertheless, the protection of the cranberry bogs against the surprises from frost to which they are particularly liable as compared with other fruits is a peculiarly difficult and there-

Conservation *for* Policyholders Decisively Exemplified *in the* Postal Life-Insurance Company

INSURANCE IN FORCE MORE THAN $50,000,000
Full Legal Reserve and Surplus for the Protection of all Policyholders

When you come to think it over—

It isn't necessary or advisable to deal with an *agent* when you want to arrange life-insurance.

From first to last, the *agency* way costs you extra money.

When you want to find out about a policy for *any* purpose—to protect the family, educate the young folks, for endowment, for business use—the *rational* way is to deal *direct* with the POSTAL LIFE.

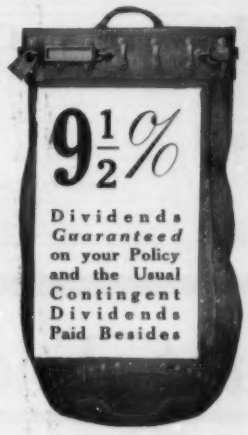
You thus escape commissions, branch-office expense, collection fees, etc., and get *full official information*—in *black and white* and binding on the Company.

The POSTAL LIFE-INSURANCE COMPANY is the *only non-agency Company in America*—the only Company that wholly eliminates agency-expense: the result is *genuine conservation in life-insurance.*

The saving is *decisive* and *permanent*, making the net cost of your insurance in the POSTAL LIFE *lower than in any other company.*

It is *always* good business to cut out the middleman when you *can*, but you can't always do it.

In arranging a POSTAL Policy, you *can* cut him out and save



money for yourself just as hundreds have done and are doing in constantly increasing numbers.

The POSTAL LIFE is even now a *large* Company with insurance in force as stated: it has policyholders in every State of the Union and in Canada, including Americans residing in foreign countries.

And these policyholders are its *friends*: they are *satisfied* and always speak good words for the Company when occasion serves.

Why not write to the POSTAL?

It has ample capital and resources to meet every demand *now* and *in the future*; it issues all the standard forms of legal-reserve insurance, and all its policies are approved by the critical New York State Insurance Department.

Here are four features (and there are others) that strongly commend the POSTAL LIFE to those who have carefully looked into it:

1. **GUARANTEED DIVIDENDS: 9½% paid to policyholders annually from savings because of the elimination of agency expense.**
2. **CONTINGENT DIVIDENDS: Made up and paid annually from other sources, these dividends being *in addition* to the guaranteed dividends and larger than other companies pay.**
3. **LIBERAL OPTIONS AND VALUES: Enabling you, among other things, to add to the face value of your Policy a larger amount of *paid-up insurance* than is possible in any other company**
4. **OPTIONAL PREMIUM PRIVILEGE: You may deposit premiums monthly, quarterly, semi-annually or annually as desired and without consulting the Company.**

In your letter be sure to state:
1. *Your Occupation.*
2. *The exact date of your birth.*

It will pay you to find out what the Company will do for you *personally*. Just write and say: "*Mail me personal particulars about insurance as per advertisement in the Scientific American.*

Postal Life-Insurance Company
THIRTY-FIVE NASSAU STREET
New York

When you write, the Postal will send no agent to visit you; it dispenses with agents.

Young Men Wanted
To Learn the **Automobile Business**
BIG PAY

Work pleasant and demand for men great. Fit yourself for position of chauffeur or repair man. We teach you by mail to become thoroughly efficient in ten weeks and assist you to secure good position. Highly endorsed—reasonable. No automobile necessary to learn—we furnish free model.
SEND FOR FIRST LESSON TO-DAY—IT'S FREE
Owners supplied with first-class chauffeurs.
Empire Auto Institute, 389 Empire Bldg., Rochester, N. Y.
The Original Automobile School

BRISTOL'S RECORDING THERMOMETERS
Instrument indoors records temperatures outdoors continuously. Write for new Bulletin No. 124.
THE BRISTOL CO., Waterbury, Conn.

Why Haven't You Sent for that Basset $1.00 Adder? Thousands Have

ADDS AND SUBTRACTS
Put one of these practical little machines on your desk or in your pocket for instant use. It adds and subtracts quickly, accurately and handily. Capacity $999,999.99. Can be quickly reset to zero. Machine measures 4x3x1 inches. Send us your order with $1.00 today, NOW, and the adder will be mailed prepaid.
Yes, it is guaranteed. Exclusive territory to good agents. J. H. BASSETT & CO., Dept. 64, 5021 Indiana Ave., Chicago, Ill.

Electric Light and Power on the Farm

ROTH Generators are excellent for this purpose. We can furnish complete outfits, including Engine, Generator, Storage Battery, Lamps, Fixtures, etc.

Only first-class apparatus handled by us. Write today.

ROTH Electric Motors
198 Loomis Street
CHICAGO, ILLINOIS

Murray Style Book

FREE

We Want Our 1911 Catalog In the Home of Every Farmer In America

178 pages filled from cover to cover with genuine Buggy, Harness and Saddle bargains; 251 illustrations, many in colors; 128 styles of Vehicles, 74 designs in harness; the biggest and best book ever printed in this line. Don't miss sending for it!

Murray Highest Award Buggies Direct from His Factory — Four Weeks Road Trial — Insures Safe Delivery—Two Years' Guarantee

Before buying any kind of vehicle, just get the 1911 Murray Style Book and compare Murray Prices with all others. Costs you nothing. You might as well have this book in your home.

The Wilber H. Murray M'f'g Co., 867 E. 9th St., Cincinnati, Ohio

Save $30.00

Send For This Free Book Right Now.

The Comptometer appeals to the Bookkeeper, Accountant,

Bill-clerk—the man who pays the bills—because:

1. It does additions in half the time possible by any other means.
2. It is the only adding machine fast enough for practical figuring of chain discounts, extending and checking bills, payrolls, costs. Let us show you by practical demonstration.
3. It is easy to operate; even your typewriter, with a few weeks' practice, can figure faster and more accurately than a skilled accountant. Brain direction, machine execution—that's the best possible system.
4. It saves time, money and worry by its rapid speed and sure accuracy. Used on all kinds of figuring by business houses all over the world.—One business house alone has 181 Comptometers in daily use.

Let us send you a booklet about it; or machine on free trial, prepaid U. S. or Canada.

Felt & Tarrant Mfg. Co., 1708 N. Paulina St., Chicago, Ill.

For Dusty Concrete Floors

Truss-Con Floor Enamel, applied with a brush, gives a wear-resisting, tile-like surface to concrete floors—becomes part of the concrete—does not peel or crack off like ordinary paints—stops dusting—easily cleaned by mopping.

Truss-Con Floor Enamel is furnished in a variety of colors for use in factories, warehouses, hospitals, power plants, hotels, schools, offices, residences, garages, etc.

Tell us condition and size of your floor. Sample booklet and color card *free*.

TRUSSED CONCRETE STEEL COMPANY
402 Trussed Concrete Building Detroit, Michigan.

Truss-Con Wall Finishes *for damp-proofing and beautifying concrete, brick and plaster walls.* **Truss-Con Paste** *for water-proofing concrete.* **Truss-Con Snowite** *for enameling interiors.*

Plant Food

A new book on fertilizers, by WILLIAM H. BOWKER.

What is the "Yeast of the Soil" and how do lime and cultivation affect it? What is it in the soil that makes certain kinds of plant food productive while under other conditions it is non-productive? The number of such questions constantly arising has led Mr. Bowker to prepare a manual on "Plant Food, Its Sources, Preparation and Application." Third edition, 100,000. Now used as a text book in many agricultural colleges and schools. In cloth, 25c. In paper covers, free. Not a line of advertising in it. Address W. H. Bowker, 43 Chatham Street, Boston, Mass.

Every tool about the place a sharp tool.

Every implement in prime condition.

These are the first essentials of efficient work in the shop, in the house or on the farm.

And they are easy if you have

Carborundum Sharpening Stones

and a Carborundum Tool Grinder. Carborundum is as hard as a diamond—and as sharp. Nothing like it has ever been discovered for putting a keen, lasting edge on tools. Carborundum will sharpen anything from a razor to a mower knife and do it better and quicker than anything else on earth.

Ask your dealer—or send direct

No. 107-F—Round Combination Stone for carpenters' tools $1.00
No. 108-F—Oblong Combination Stone for general use 1.25
No. 191-F—Scythe and Grass Hook Stone 25c
No. 146-F—Pocket Stone, in neat leather case 35c

Carborundum Niagara Tool Grinder for shop or home use, hand or foot power, $2 to $15

Write for the book

The Carborundum Company, Niagara Falls, New York

fore attractive problem, and to this problem the Bureau has turned its earnest attention. The work in this line was begun some years ago by the present chief of the Bureau, and has latterly been taken up by Prof. Cox, who has just published a complete account of his work in the form of a Weather Bureau bulletin. This bulletin is commended to the attention of any one who desires to see, in the first place, how many factors may enter into the problem of making practical rather than academic forecasts for a particular industry, and, in the second place, how thoroughly the Weather Bureau investigates every side of such a question. It is not simply a matter of saying when such and such a temperature will prevail generally over the area in which the bogs are located. The season of the year, the temperature of the soil as determined by previous rather than by current meteorological conditions, and finally various local peculiarities of the bogs, all have to be taken into account before the forecaster is justified in warning the growers that flooding—the usual method of protection—is in order.

THE FLOOD SERVICE.

The Weather Bureau points with pride to its River and Flood Service as the branch of forecasting in which—to use a hydrological metaphor—the high-water mark of accuracy has been attained. The Bureau is charged by Congress with the duty of gaging the rivers of the United States and issuing flood warnings. I have not space to describe the elaborate organization of this service, with its gages along every large river and its corps of 600 special river and rainfall observers, who receive a small compensation for a few minutes of their time each day. This work, again, is one calling for the highest talents and the utmost fidelity on the part of the few men to whom it is intrusted—the Chief of the River and Flood Division at Washington, and the officials in charge of the 55 river districts into which the country has been divided. Thanks to their energy and enterprise, the bureau is able to predict the stage of a river at a given point, within a limit of error of a few inches, from three or four days to *three weeks* in advance. When it is considered that thousands of square miles of agricultural land are subject to overflow in a time of high water, the enormous value of flood warnings to the farmer will be appreciated.

MATTERS THAT ARE FUNDAMENTAL.

The work of the Weather Bureau for agriculture represents the application, on a truly colossal scale, of knowledge that has been slowly and painfully acquired—in part by men who hardly know a plow from a harrow. *Non omnia possumus omnes;* a machine needs to have many parts, each with its appointed work to do. So it happens that some of us must stay at home and manufacture the ammunition that the army in the field is to put where it will do the most good.

The headquarters staff of the Weather Bureau has its own tasks and its own problems. How some of these concern the farmer I shall try to show.

Agriculture is compounded of climate and soil, and the more we know about these two things the better use we can make of them. The study of the climate of the United States is officially allotted to the Weather Bureau, that of the soil to the Bureau of Soils; but the two subjects overlap to some extent.

The archives of the Weather Bureau contain millions of meteorological observations, some of them dating back a hundred and fifty years. These observations are the raw material from which climatic statistics are made; and the work of putting the latter into final and usable form has been done largely, though by no means entirely, at the central office of the bureau in Washington. These statistics are directly or indirectly useful to the farmer in a variety of ways. They tell him, in the first place, just what parts of the country have, on an average, sufficient rainfall and sunshine to make farming a profitable venture, and in the second place, after he has chosen his farm, they tell him what crops it is best adapted to produce. If he has settled in a semi-arid region, they tell him whether, and to what extent irrigation will be necessary; or, if he is a dry farmer, which of the several regimens of dry farming will be the most appropriate. The importance the farmer attaches to such information is shown by the extent to which it is sought. At some of the western stations of the Bureau it is said that from 30 to 50 per cent of the correspondence is with persons seeking information regarding the climate of agricultural and pastoral lands.

Indirectly the same statistics serve the farmer by facilitating the work of plant introduction so extensively carried on by another branch of the Department, the Bureau of Plant Industry; and, to a greater or less extent, they enter into nearly all experiments undertaken, officially or otherwise, for the improvement of agriculture in this country.

So much for geographical climatology. There are, however, many other branches of meteorology that play their part in scientific agriculture.. There is phenology, for example—still a baffling subject, in spite of the enormous amount of labor that has been expended upon it; there is evaporation, which, though it still refuses to submit itself to general formulæ, has been studied empirically with practical results; there is solar radiation—a subject of the utmost importance to agriculture, which, for lack of proper appliances, has been neglected until quite recently, but has now been taken up by the most progressive meteorological institutions of the world. In these subjects, and many more, the Weather Bureau is doing, or has done, its part; and if the farmer has not been the sole beneficiary, why so much the better for the rest of the community.

The Weather Bureau is not afraid of the word "research." It has put this word into the title of the institution of which it is most proud—the Mount Weather Research Observatory. Of this fine institution I have not space to write, beyond stating that it is a standing refutation of the idea that the government is doing nothing for pure science.

PROGRESS.

Humanity moves ahead at a breathless pace nowadays. We rarely take time for retrospection; when we do, we are amazed to find how much ground we have covered since we last took stock of our progress.

In looking back over the past few years, I find that some of the latest advances made by the Weather Bureau are almost revolutionary. Take the newspaper weather map—officially called the "Commercial Weather Map," but quite as interesting to the farmer as to the merchant. A year ago it did not exist as an official undertaking. The Bureau published its own maps, in the form of broadsides, issued from a hundred stations. Their total circulation was forty or fifty thousand. A happy inspiration suggested the utilization of the vast machinery of the daily press for the dissemination of the same information. Today the map is published in a hundred newspapers, and reaches, say, twenty million people daily.

The daily synoptic chart of the northern hemisphere, and its corollary the weekly long-range forecast, are products of the last three of four years. This ambitious undertaking is an expression of the most advanced conceptions of the proper scope of meteorology. Very lately we have found out how intimate is the relation between widely separated regions of the atmosphere. We know, for exam-

ple, that the height of the barometer at Buenos Aires is not unconnected with the monsoon rainfall of India, and that the strength and direction of the air-currents over the South Atlantic Ocean have a great deal to do with the Nile flood. "Correlative meteorology" is engaging the attention of an army of investigators all over the world, and an international commission has lately been formed to direct the study of this fascinating subject. In the practical utilization of the idea America leads the world, and the United States Weather Bureau is, up to date, the only institution that assembles daily, by cable, the meteorological observations of a chain of stations extending around the globe, and makes them serve as the basis of weather forecasts.

The daily weather map of the northern hemisphere is prepared in manuscript at Washington, and is not published. With its aid the forecaster is enabled to feel the pulse of the atmosphere as a whole—not merely the limited portion of it that happens to lie over the United States. It would be rash to predict what this experiment will ultimately lead to, but to the forecaster it has brought the sense of relief resulting from the removal of the narrow bounds that formerly hemmed in his view. The tangible result to the public, up to the present moment, is the publication of a forecast every Sunday of the broad features of the following week's weather—the prospects of general rains over the corn belt; the danger of spring frosts in an important truck country; the probable course and rate of movement of large cyclonic and anti-cyclonic areas—sometimes traced from a point of origin on the western side of the Pacific—and the weather likely to attend them over an extensive region. Just how much these wholesale forecasts of weather mean to the agricultural public each farmer must decide for himself. As a factor in determining the prices of farm products they have already made themselves felt, and therefore no farmer can be altogether indifferent to them.

THE KEYSTONE OF THE ARCH.

The foregoing is only a fragmentary description of what the Weather Bureau is doing to-day for American agriculture. An exhaustive presentation of the subject would fill a volume.

When I began to write I intended to refrain from the congenial task of eulogizing the two men to whom, above all others, is due the credit for the remarkable progress the Weather Bureau has made during the past decade, and for the enviable position it now occupies as an agency in promoting the nation's welfare. A compliment paid to one's official superiors is apt to sound perfunctory.

However, in bringing my story to a close I seem to have built a more or less elaborate arch and left out the keystone.

Prof. Willis Moore is much more to the Weather Bureau than its official head. He is himself the embodiment of its spirit. The best qualities that distinguish the rank and file of the service are his qualities, more or less successfully emulated by men who look to their chief for example no less than for precept.

To Secretary James Wilson the Weather Bureau is indebted not only for freedom to develop itself without harassing restrictions, but for active aid and encouragement at every stage of the process. There have been cabinet ministers—in America and elsewhere—who have laid a heavy hand of bureaucracy and narrow utilitarianism upon the scientific idealists serving under them. I have in mind the complaint recently made by the director of one of the foreign weather services that the official Shylocks are perpetually clamoring for "results," and are only momentarily appeased with the news that some unpromising argosy of investigation "hath richly come to harbor suddenly."

It is a privilege to be able to point to the present Secretary of Agriculture as an official of exactly the opposite type. The Weather Bureau is what he has helped and encouraged the present chief of the Bureau to make it.

Neon Light

By Our Berlin Correspondent

MR. GEORGES CLAUDE, the well-known pioneer in the field of gas liquefaction, recently submitted to the French Physical Society the results of his work on neon light.

The remarkable brilliancy possessed by the spectrum of that gas and the fact discovered by Collu, that a glass tube containing neon and a mercury globule is made to shine by shaking in the dark, induced Mr. Claude to undertake some experiments on the possible use of that gas for lighting purposes, the more so as according to Prof. Bouty's work, its dielectric constant is extremely low.

His attempts to improve the light of mercury tubes by combination with neon light failed to give any satisfactory results. Endeavors made to use pure neon directly as a source of light proved far more successful, though the fact that neon is liable to be contaminated with traces of foreign gases (mixed with it from the start or disengaged by the electric current from the electrodes and the walls of the tube) caused much difficulty. These drawbacks were eventually overcome by fitting the neon tube with a carbon reservoir immersed in liquid air, as it is well known that charcoal at low temperatures has a strong absorbing action upon gases.

At the recent Paris automobile show, Claude in conjunction with the Moore company installed four neon tubes, each 36 meters in length, which gave quite surprising decorative effects. As the light of these tubes is very rich in red rays, the facade of the Grand Palais seems to be immersed in a sea of bright golden light.

As no accurate data on the Grand Palais installation are so far available, Claude in the meantime gives an account of the working conditions of a tube six meters in length and forty-five millimeters in diameter exhibited before the Physical Society.

The potential difference between the terminals of this tube, on account of the low dielectric constant of neon, is only about 1,000 volts; just as in the case of the arc discharge, this potential difference is found to decrease somewhat with increasing current intensities, dropping from 1,100 to 980 volts as the current intensity increases from 0.1 to 1 ampere. With a potential difference of 1,000 volts and a current intensity of 0.94 to be 850 watts, corresponding to a power factor of 0.9, about the same as observed by Wedding in Moore tubes filled with nitrogen.

Photometric measurements made by the Wedding method on a strip of tube several centimeters in length showed the luminous intensity to be 220 candle-power per meter, corresponding to a total of 1,320 candle-power.

Considerably better results should be obtainable in longer tubes, since much energy is lost at the electrode, a loss which remains constant as the length of the tube is increased. As measured by means of auxiliary electrodes, this loss amounts to as much as 300 watts with a total energy consumption of 850 watts.

Agricultural Colleges and Schools

SINCE October, 1908, the number of institutions in the United States giving instruction in agriculture has increased from 545 to 875. Departments of agricultural instruction have been established in 38 public high schools; 214 institutions now give teachers' training courses in agriculture. Farmers' institutes are now organized in every State; the attendance at the institute metings was 2,395,908. Ninety-nine movable schools of agriculture were held, with an attendance of 65,977.

1911 ATLAS OF THE WORLD GIVEN FREE

With New Census

To the readers of THE SCIENTIFIC AMERICAN who take advantage of this **Offer** now made in connection with

Webster's NEW International

Not A New Edition A Mere Revision But a New Creation

WEBSTER'S NEW INTERNATIONAL DICTIONARY
THE LATEST AUTHENTIC EDITION OF THE MERRIAM SERIES
WEBSTER'S NEW INTERNATIONAL DICTIONARY
G.&C. MERRIAM CO.

In Rich, Full Red Leather Binding.

400,000 Words and Phrases

6,000 Illustrations

3,000 Pages

New Gazetteer of the World

New Biographical Dictionary

Readers of THE SCIENTIFIC AMERICAN can now secure this **Newest** and **Most Complete Reference Library** in Dictionary Form on the following remarkably easy terms: The entire work in full leather (with Atlas)

Delivered for $1.00

and easy payment thereafter of only a few cents a week in the United States or Canada.

Highest Praise from Eminent Authorities

Nicholas Murray Butler, President Columbia University: "Marks new advances even upon its excellent predecessor."

President Harris, Northwestern University: "Much pleased with new horizontal division of the page."

President Jordan, Leland Stanford Jr. University: "Pleased with the compactness and accuracy of the definitions."

President Faunce, Brown University: "It is an encyclopedia covering the entire territory of the world's knowledge and the world's action."

To those who respond **AT ONCE** we will send a copy of an amusing "Test in Pronunciation" (with key), entitled "The Americanization of Carver," and also a "Red Fac-simile Booklet" of interesting questions, with references to their answers.

The ATLAS

is the New Census 1911 "New Reference Atlas of the World," containing 128 pages of maps, beautifully printed in colors with marginal reference indexes, besides illustrated description of **PANAMA CANAL,** all handsomely bound in red cloth, size 10¾ x 13⅜.

Mail this coupon at once to

G. & C. MERRIAM CO.
SPRINGFIELD, MASS.

Sole Publishers of GENUINE Webster Dictionaries for over 67 Years

Home Office (Coupon)

G. & C. MERRIAM CO., Springfield, Mass.:

Please send me, free of all obligation or expense, a copy of "Test in Pronunciation" and also "Red Fac-simile Booklet," with special terms of your SCIENTIFIC AMERICAN free Atlas offer on the enlarged edition of "Webster's NEW International Dictionary."

Name .....

Address .....

.....

BUY THE LOWEST COST ENGINE

MADE. Lowest fuel cost; lowest up-keep cost; easiest on the machine it operates, delivering steadier power than any other gasoline engine, adapting it especially for operating farm machinery, with better results and least waste of grain. Lowest fuel cost for it runs on Gasoline, Kerosene, Distillate, Gas or Alcohol and has perfect lubrication Lowest cost because it delivers greatest available power per horse. A slow speed, high duty engine. Starts easier and quicker than any other engine, occupies less space, is less cumbersome, with less vibration, therefore adapting it for either stationary, portable or traction use. **IT IS THE POWER CONTRACTOR'S FAVORITE ENGINE.** No engine made has so wide a range of use. **YOU WILL MAKE A MISTAKE IF YOU DO NOT WRITE US FOR INFORMATION.** 1½ H. P. to 5½ H. P. single cylinder, 6 to 20 H. P. two cylinder, 30 to 50 H. P. four cylinder. State your requirements and get our advice **THE TEMPLE PUMP CO., Manufacturers, 417 West 15th St., Chicago, U. S. A.** This is our 58th year.

A REMARKABLE OFFER OF HENDERSON'S SPECIALTIES

To demonstrate the superiority of Henderson's Tested Seeds, we have made up six of the best we have, into a Henderson Collection, consisting of one packet each of the following great specialties:

Ponderosa Tomato
Big Boston Lettuce
Scarlet Globe Radish
Henderson's Invincible Asters
Mammoth Butterfly Pansies
Giant Spencer Sweet Peas

To obtain for our annual catalogue **"Everything for the Garden,"** described below, the largest possible distribution, we make the following unusual offer: To everyone who will mail us ten cents, mentioning this publication, we will mail the catalogue and also send our Henderson Specialty Collection as above.

Every Empty Envelope Counts as Cash

This Collection is enclosed in a coupon envelope, which when emptied and returned will be accepted as 25c. cash payment on any order of one dollar or over.

"EVERYTHING FOR THE GARDEN"

our 1911 catalogue, is without exception the best we have ever issued. 208 pages, 8 colored plates, 800 photo engravings, showing actual results without exaggeration, make it the most complete as well as beautiful horticulture publication of the year. Also contains full cultural directions for flowers and vegetables.

PETER HENDERSON & CO. 35 & 37 CORTLAND ST. NEW YORK CITY

6% for 23 Years
paid by A-R-E 6's

ISSUED and offered by the American Real Estate Company, based on its ownership of selected New York real estate.

¶ For 23 years these Bonds have paid 6%, returning nearly $5,000,000 to investors, and enabled thousands of persons to share in the profits from New York real estate.

¶ For 23 years this Company has operated successfully in this field, and its original capital of $100,000 has increased to a Capital and Surplus of over $2,000,000, with Assets of over $23,000,000.

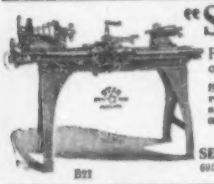
¶ In the further extension of its business the Company offers its 6% Gold Bonds in these two forms:

6% COUPON BONDS
For those who wish to invest $100 or more.

6% ACCUMULATIVE BONDS
For those who wish to save $25 or more a year.

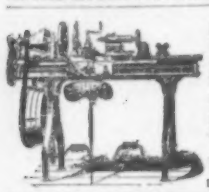
¶ Send today for descriptive literature, latest illustrated statement, and map of New York City showing location of properties.

American Real Estate Company
Capital and Surplus - - $2,011,247.80
Founded 1886 :: Assets, $23,026,889.67
Room 627 527 Fifth Avenue, New York



"Star" Lathes Large line of Attachments
For Foot or Power
Suitable for fine accurate work in the repair shop, garage, tool room and machine shop.
Send for Catalogue B
SENECA FALLS MFG. CO.
695 Water St., Seneca Falls, N.Y.

THE SEBASTIAN 15-INCH ENGINE LATHE
HIGH GRADE LOW PRICE
Automobile Builders, Garages, Repair and General Jobbing Shops find this the ideal lathe for their work. Catalog free.
The Sebastian Lathe Co., 120 Culvert St., Cincinnati, Ohio



FOR GUNSMITHS, TOOL MAKERS, EXPERIMENTAL & REPAIR WORK, ETC.
From 9-in. to 15-in. swing. Arranged for Steam or Foot Power, Velocipede or Stand-up Treadle.
Send for Lathe Catalog.
W. F. & JNO. BARNES CO.
Established 1872.
1999 Ruby St., Rockford, Ills.

CROBET Swiss Files
and other tools shown in "The Tool-Monger." This 375-page catalog mailed on receipt of 6 cents in postage stamps.
MONTGOMERY & CO., 109 Fulton Street, New York City

DO YOU USE GRINDSTONES?
If so we can supply you. All sizes mounted and unmounted, always kept in stock. Remember, we make a specialty of selecting stones for all special purposes. *Send for catalogue "I."*
The CLEVELAND STONE CO.
6th Floor, Hickox Bldg., Cleveland, O.

AEROPLANE BLUE PRINTS
CURTISS, WRIGHT, BLERIOT, OR SANTOS-DUMONT
Blue print drawings with complete directions for building any one of the above Aeroplane Models. 25 cents postpaid. International Aeroplane Co., S 628 World Building, N. Y.

AGENTS 100% PROFIT

15 In One
Just out. Patented. New Useful Combination
Low priced. Agents amazed. Sales easy. Every home needs tools. Here are 15 tools in one. Essex Co., N. Y. agent sold 100 first few days. Mechanic in shop sold 50 to fellow workmen. Big snap to hustlers. Just write a postal—say: Give me special confidential terms. Ten-inch sample free if you mean business.
THOMAS MFG. CO., 5863 Wayne Street, DAYTON, OHIO

The Elkins Saw Filer and Clamp
is a useful Tool in every carpenter's shop. It holds and files a Saw to perfection, is Always ready for use. complete in itself.

It is light, strong and durable, with no loose parts to get lost or out of order.
A. J. WILKINSON & CO.
MACHINERY & TOOLS
184-188 Washington St.,
Boston, Mass.
Saves time and saves files. Adapted to all saws except circular.
$2.50

Ideal Lawn Mower Grinder
1911 MODEL NOW READY
Better than ever before. Ball-bearing Main Shaft and Grinding Wheel. Grinds all makes of Mowers perfectly in 15 minutes without removing wheel or catcher. SEND TO-DAY for full description of this wonderful labor-saver and money-maker. Will more than pay for itself first season because it does the work so much quicker and better. Skate Sharpener Attachment for sharpening skates. Over 5,000 in successfully managed.

HEATH FOUNDRY & MFG. CO.
PLYMOUTH, - OHIO.

Electricity

Compulsory Wireless Telegraphy.—An order has been issued by the Italian government making it compulsory for all vessels carrying emigrants from Italian ports to be equipped with wireless telegraph apparatus of the Marconi type. These equipments must have a range of at least 187 miles.

Pocket Receiver for Radiotelegraphy.—It is announced that Prof. Belar of the Laibach Observatory has invented a cheap and handy pocket receiver for wireless telegraphy. Experiments with this new instrument are said to have been most successful. No detailed information as to the construction or mode of operation of the invention is available.

Metal Sheath for Return Circuit.—In Germany rubber-insulated wires are ordinarily protected by steel tubes, which are joined together by overlapping. Experiments have recently been made to determine whether these tubes may not be used for a return circuit or an earthed neutral wire. It was found that they answered the purpose admirably, and that the voltage drop at the joints was considerably less than the maximum permission.

Electric Trucks for Docks.—In order to facilitate the handling of freight and express matter on steamship docks, the Hamburg-American line has recently been experimenting with electric trucks. The company has adopted a truck mounted on three wheels, capable of carrying a load of 5,000 pounds at the rate of four miles per hour. It has been proven that one of these trucks will do the work that heretofore required six men with the common hand trucks.

Incandescent Lamps in Germany.—Our consul at Bremen, Germany, states that the export trade in incandescent lamps from Germany has grown yearly. In 1909 it amounted to $7,857,000, as against $4,780,000 in 1908. The lamps were exported to Great Britain, Austria-Hungary, Russia, Denmark, and Italy. On the other hand, our consul at Vienna, reporting on incandescent lamps exported from Austria-Hungary, states that the entire value for 1909 was $816,343, of which the larger part was sent into Germany.

Annual Electrical Shows.—The success of electrical shows throughout the country has been so great that they have become an annual feature in several cities. This year Minneapolis, Minnesota, has held its second annual electrical show, extending from January 6th to February 4th, and as usual in such exhibits the illumination was exceedingly attractive. Electrical shows are now held annually in New York, Chicago, Philadelphia and Minneapolis. One of the leading features of the shows this year has been the development of the electrical vehicle. Electricity in the household attracts, perhaps, the most popular interest in these exhibits.

Resistors and Insulators for Electric Heating Appliances.—In a recent address given before the Chicago branch of the American Institute of Electrical Engineers, Mr. Charles P. Madsen discussed the subject of "Electric Heating Development." He referred to the three classes of materials used for the resistor; first, loose compositions, which develop heat owing to loose contact, but which are objectionable owing to the fact that with the rise of heat the resistance is reduced; second, the chemical precipitates, in which a thin conducting deposit on an insulating material serves as the resistor, and third, the various metal wires. Of the last class, alloys of nickel-copper and nickel-chromium have proved the most satisfactory. In connection with these resistors, the subject of insulating materials which will also resist the action of heat is important. Lava, porcelain and mica have proved the most successful, while asbestos, glass and water glass lose their efficiency when heated.

Engineering

Steel Mail Cars.—A provision has been inserted in the Post Office appropriation bill to the effect that hereafter the Postmaster General must make no contracts for any mail cars other than those built of steel or some non-combustible material. A stipulation was also included that after January 1st, 1916, no wooden car shall be used in any way for the railway mail service.

All-steel Suburban Coaches.—The first delivery of all-steel suburban coaches for use of the suburban service of the Pennsylvania Railroad in New York, has been made. The coaches, which are 54 feet long, seat 82 people, and by intelligent design the dead weight of the car per passenger has been reduced from 1,510 pounds in the old wooden coaches to 1,078 pounds in the steel coaches.

For Erecting Gatun Lock Gates.—A suggestion of the massive character of the Panama Canal lock gates is found in the recent delivery at the Isthmus of two truss bridges 11 feet wide and 134 feet long, which will span the locks and be used for erecting the massive lock gates. Each bridge will carry a railroad track, from which locomotive cranes will handle the steel during erection.

Bigger Drydocks Needed.—Ships like the "Mauretania" and the new "Olympic," 790 and 882½ feet long, respectively, cannot dock on this side of the Atlantic. The largest dock at New York, situated at the navy yard, is only 700 feet long, and there would certainly seem to be a call for the construction for one at this port with a usable length of not less than one thousand feet.

California Road Improvements.—Voters of the progressive State of California have ratified an act of the Legislature calling for a bond issue of eighteen million dollars to construct a system of State highways connecting the county seats of California. More than this, various counties have authorized bond issues for road improvement to a total amount of $7,300,000. California is certainly alive to its interests.

Proposed Interstate Hudson River Bridge.—The New York Interstate Bridge Commission has filed a report at Albany declaring in favor of a site for a Hudson River bridge with a main span of 2,800 feet, between 57th and 63rd Streets. If constructed, this will be the longest span in the world, the next longest, in their order, being the Forth bridge of Scotland, 1,710 feet; Williamsburg Bridge, New York, 1,600 feet; Brooklyn Bridge, 1,595 feet, and the Manhattan Bridge, New York, 1,470 feet.

New Warship Construction.—The House Naval Committee bill calls for the expenditure of $125,421,538, of which $34,270,816 is for new warships. The programme provides for two 27,000-ton battleships, to cost $11,835,408 each; two colliers, eight torpedo boat destroyers, and four submarines, the latter to cost $500,000 each. The committee recommends the repeal of the provision in last year's naval act, calling for the construction of the battleship "New York" at the New York Navy Yard. This change was recommended on account of the much greater cost of navy yard construction.

Removing Quebec Bridge Wreck.—When the Quebec Bridge collapsed 17,000 tons of steel fell into the St. Lawrence River, about one-half of it, constituting the anchor arm, being in shallow water. In removing this material, much of which is in large and heavy sections, the metal has been cut to sizes that can be handled, partly by dynamite and partly by the use of the oxy-acetylene torch. In cutting a member in two by dynamite a continuous row of dynamite sticks is attached on the line on which it is desired to cut and explode. According to the *Engineering Record*, it costs about $1 a ton to reduce the compression members to scrap, which is sold in Montreal for $12 a ton.

Nulite Gasoline Table Lamp
A beautiful lamp for homes, hotels, offices, stores, banks, cafes. Portable, safe; can be turned upside down or rolled on the floor without danger or affecting the light. 300 C. P. of soft, brilliant light, one-third cent per hour. Also 200 different styles of lamps and systems.
AGENTS—We want town, county, and traveling salesmen. Best proposition ever offered. Sells everywhere. Write for Special Offer.
CHICAGO SOLAR LIGHT CO.
212 So. Jefferson Street CHICAGO

CRUDE ASBESTOS
DIRECT FROM MINES
PREPARED ASBESTOS FIBRE for Manufacturers use
R. H. MARTIN, OFFICE, ST. PAUL BUILDING 220 B'way, New York.

MASON'S NEW PAT. WHIP HOIST
for Outrigger hoists. Faster than Elevators, and hoist direct from teams. Saves handling at less expense.
Manfd. by VOLNEY W. MASON & CO., Inc. Providence, R. I., U. S. A.

RUBBER Expert Manufacturers Fine Jobbing Work
PARKER, STEARNS & CO.,
288-290 Sheffield, Ave., Brooklyn, N. Y.

THE SCHWERDTLE STAMP CO. STEEL STAMPS, LETTERS & FIGURES BRIDGEPORT CONN

Cheapest Water Supply for Country Homes
The Niagara Hydraulic Ram will give you running water in any part of your home or barn without any operating cost whatever.
Niagara Hydraulic Ram
pumps by water pressure. Cheaper than gasoline engine or windmill. Write today for catalog AA and guaranteed estimate.
NIAGARA HYDRAULIC ENGINE CO.
40 Nassau St., N.Y. FACTORY, CHESTER, Pa.

TELESCOPES
W. & D. MOGEY
PLAINFIELD, N. J.

BROOMELL'S VACUUM CLEANER
The "VICTOR"
"'Tis the finest in the Land."
Electric Portable ¼ H. P. motor—a perfect machine. Electric Stationary 1 H.P. motor. You can install it yourself in two hours time. Only one pipe required, made from slip joint nickel-plated tubing, furnished with machine. Buy direct and save money.
Victor Cleaner Co., Manufacturers, YORK, PA.

M. P. SCHELL MANUFACTURING CO.
Manufacturers of Special Machinery, Patented Devices, Metal Articles, Tools and Dies. Gear Cutting, Punching Work. **Models and Experimental Work.**
509-511 Howard St., San Francisco, Cal.

MODELS CHICAGO MODEL WORKS 125 MADISON ST. CHICAGO

INVENTORS Let us build your model before you apply for a patent. Advice free.
G. SCHWARZ & CO., 123 Liberty St., N. Y.

DIE MODELS SPECIAL WORK TOOLS MACHINERY
NATIONAL STAMPING AND ELECTRIC WORKS
216-220 S. Jefferson Street, Chicago, Ill.

Models & Experimental Work
INVENTIONS DEVELOPED
SPECIAL MACHINERY . . .
E. V. BAILLARD CO., 24 Frankfort St., N. Y.

HELMET OIL LUBRICATES ANYTHING SEND FOR SAMPLE FREE
118-124 North Clinton St.
CHESTER A. CO. CHICAGO U.S.A.

Experimental & Model Work
Circular and Advice Free
Wm. Gardam & Son, 221 Fulton St., N.Y.

ICE MACHINES Corliss Engines, Brewers' and Bottlers' Machinery.
The VILTER MFG. CO.
899 Clinton Street, Milwaukee, Wis.

FASCINATING STORE WINDOW DISPLAY
Magic Electrical Optical Illusion Box
Makes articles appear and disappear.
IT SELLS YOUR GOODS
Buffalo Electrical Laboratory
147 Erie Co. Bank Buffalo, N. Y.

10 DAYS FREE TRIAL
We ship on approval without a cent deposit, freight prepaid. DON'T PAY A CENT if you are not satisfied after using the bicycle 10 days.
DO NOT BUY a bicycle or a pair of tires from anyone at any price until you receive our latest art catalogs illustrating every kind of bicycle, and have learned our unheard of prices and marvelous new offers.
ONE CENT is all it will cost you to write a postal and everything will be sent you free postpaid by return mail. You will get much valuable information. Do not wait, write it now
TIRES, Coaster-Brake rear wheels, lamps, sundries at half usual prices.
Mead Cycle Co. Dept. T175 Chicago

Aeronautics

Another Aeroplane Fatality.—While descending from a height of 250 feet in a new military monoplane at Douai, France, on February 9th, the wings broke off and MM. Noel and Delatorre were killed.

An Emergency Appropriation for Aeroplanes.—At the request of Major General Leonard Wood, Chief of Staff, Senator Warren offered an amendment to the army appropriation bill to the effect that $25,000 of the total of $125,000 for aeronautics be made immediately available for the purchase of aeroplanes. This amendment was passed, and General Allen, of the Signal Corps, is now negotiating for the purchase of several heavier-than-air machines.

The Second Aero Show at Boston.—The second annual aeronautic show will be held in Mechanics Building, Boston, from the 20th to the 25th instant. Many more aeroplanes will be shown than were exhibited last year, as well as a big line of aeronautic accessories. The latest models of Wright and Curtiss biplanes will be exhibited, as well as those of the less well known manufacturers. A feature of the show will be the man-carrying kites of Samuel F. Perkins with which he has lately sent two men aloft from the cruiser "Pennsylvania."

Harkness Makes Military Flight.—On February 7th Mr. Harry Harkness, the amateur aviator who has heretofore had but small success in flying his Antoinette monoplane, flew from Fort Rosecrans, near San Diego, to the American camp on the Mexican border at Tia Juana. He carried a weighted message from Major McManus to Lieut. Ruhlin, who was in charge of the troops. Circling above the camp at a height of 100 feet, Harkness dropped the message and returned. His flight lasted 56 minutes, and for a good part of the way he was over the ocean. The total distance covered was about 46 miles, and the average speed nearly 41 miles an hour.

Real Scouting by Aeroplane.—Mr. R. F. Collier has loaned the War Department his new Wright biplane, and Lieut. B. D. Foulois has been commissioned to fly it above the Mexican border during the hostilities now going on between the Mexican government and the insurgents. There are 1,400 miles of border to be patrolled, and the government has called for volunteer aviators to help perform this duty. In response, Charles K. Hamilton volunteered his services, and on February 10th, in an 18-minute flight, crossed the Rio Grande from El Paso, Texas, and reconnoitered at an altitude of 1,000 feet above Juarez, locating Mexican troops.

England's New Naval Airship.—Further particulars are now available respecting the naval airship now under construction for the British government at Barrow-in-Furness, England. The propulsive power is derived from two sets of eight-cylinder Wolseley engines of 200 horse-power each. To each of these engines are attached eight sheet metal tanks, each having a capacity for 2,000 gallons of gasoline. The total storage capacity is 32,000 gallons. These tanks are welded together in oil-tight sections, insuring the buoyancy of the airship should an accident or injury occur to any section. The precaution, however, entails the addition of some 300 yards of aluminium piping. The engine is designed to run at 500 revolutions per minute, and a speed of 45 miles an hour is expected to be obtained from the three propellers. The lifting power is 21 tons, 4½ tons more than that of the "Zeppelin VIII." The length is 510 feet, maximum diameter 48 feet, gas capacity 706,336 cubic feet. The envelope is constructed of silk, and is divided into seven sections. Very thorough tests are being made, and trial flights will shortly be undertaken. The framework has been constructed of duralium, a new alloy of aluminium, which is lighter and stronger than pure aluminium.

Science

Height of the "Upper Inversion" in the Atmosphere.—According to a recent discussion of the temperature of the upper air by Albert Peppler, the following figures represent the average altitude of the "upper inversion" at various latitudes, as deduced from the abundant data of observation now available: North pole, about 8 kilometers; northern Europe, 10.69 kilometers; central Europe, 10.98 kilometers; southern Europe, 11.20 kilometers; 30-37 deg. N., 13.05 kilometers; 19-30 deg. N., 14.51 kilometers; 1 deg. S. (German expedition to East Africa), 15.21 kilometers.

The Highest Kite Flights.—The art of flying kites is carried to its greatest perfection at the large aerological observatories, and the best records of altitude up to date have been made at Mt. Weather, Va., and Lindenberg, Germany. The former station is 525 meters above sea level, the latter only 120; a circumstance that should be remembered in comparing the records made at the two places. The following list of the highest flights, recently published by Dr. Assmann, gives the altitude above the ground, not above sea level: 1, Mt. Weather, 6,740 meters; 2, Lindenberg, 6,660 meters; 3, Mt. Weather, 6,519 meters; 4, Mt. Weather, 6,484 meters; 5, Lindenberg, 6,380 meters; 6, Mt. Weather, 6,379 meters.

A Proposed International Magnetic Union.—Dr. L. A. Bauer, director of the Department of Terrestrial Magnetism of the Carnegie Ir titution, contributes to the current number of *Terrestrial Magnetism and Atmospheric Electricity* a long review and criticism of the career of the International Commission on Terrestrial Magnetism. This commission is now a subordinate body under the control of the International Meteorological Committee, a circumstance arising from the fact that in nearly all countries the official magnetic service is identical with the official meteorological service. Dr. Bauer's editorial leads up to a plea for an independent International Magnetic Union, organized on similar lines to those of the International Union for Co-operation in Solar Research.

The Earth from the Moon.—As we look up through the transparent atmosphere on a clear night and see the moon beaming brilliantly down upon us, every one has at times been moved to speculate upon the wonderful sight the continents and oceans of the earth must present when viewed from the lunar regions. As a matter of fact, however, we are assured that a man on the moon would catch but fleeting glimpses of the outlines of our continents. One authority has stated that the true radiating surface of the earth, as a planet, is chiefly the water vapor at an elevation of 4,000 meters (13,120 feet), or more, above the sea level. In consequence the man in the moon would see the features of the earth dimly outlined in the glare of light reflected from the atmosphere.

The Climate of Queensland.—The Water Supply Department of Queensland has just published an important collection of rainfall statistics, compiled from the observations made at over five hundred points in the State during the ten years 1897-1906, inclusive. Data of the other climatic elements are to be published in a separate volume. These publications will fill a serious gap in the literature of geographical climatology, and, in addition to their scientific value, will benefit this portion of Australia by correcting false impressions concerning its climate that have doubtless kept away many homeseekers. Queensland has been described as an almost waterless desert, but the rainfall data just published tell quite a different story. On the northeast coast the rainfall far exceeds the requirements of agriculture, while even the stations of the far interior have about the same amount of rain as have the dry-farming regions of our own western plains.

WEST·INDIES

TWO 21 DAY CRUISES

by the palatial Steamship **Hamburg** (10,500 tons), sailing from New York, February 21 and March 18. **Cost $125 and upward.**

TWO SPECIAL CRUISES by the **S.S. Moltke** (12,500 tons), leaving New York February 28. Duration 28 days, **cost $150 and up.** Spring cruise of 16 days duration leaving New York March 28. **Cost $85 and up.**

JAMAICA

24 AND 25 DAY CRUISES

to Jamaica, Hayti, Colon, **Panama Canal,** Costa Rica, Columbia. Weekly sailing by the splendid "Prinz" Steamers of the **Atlas Service. Cost $135 and 140 and upward.**

Write for full information describing these and other pleasure cruises to the Orient, West Indies, Around the World, etc.

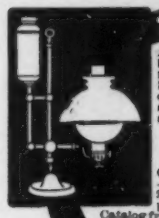
HAMBURG-AMERICAN LINE, 45 Broadway, New York

Boston Philadelphia Pittsburg Chicago St. Louis San Francisco

MAKE MONEY FROM OTHERS' FUN

Owners of our Famous Merry-Go-Rounds frequently make from $8,000 to $10,000 yearly. It is a big-paying, healthful business. Just the thing for the man who can t stand indoor work, or is not fit for heavy work and has some money to invest in a money-maker. We make everything in the Riding Gallery line from a hand-power Merry-Go-Round to the highest grade Carousselles. They are simple in construction and require no special knowledge to operate. Write to-day for catalogue and particulars.

HERSCHELL-SPILLMAN COMPANY
167 Sweeney St., North Tonawanda, N. Y.



2¢ A WEEK

A safe, very brilliant, powerful, steady, white light. Is better than electricity or acetylene and cheaper than kerosene.

Every lamp is a complete self-contained miniature light works.

Clean—bright—odorless—portable. Made in over 200 styles for every purpose. Fully guaranteed. Catalog free. Agents wanted.

THE BEST LIGHT CO.
87 E. 5th Street
Canton, O.

THE "BEST" LIGHT

Money Back If Books Are Not Satisfactory

Actual size of each volume, 7¾"x4½"x1"; 500 pages to the volume. Beautifully bound in red buckram, tastefully lettered in gold.

Here's the Whole World's Scientific Knowledge, Written So You Can Understand It

For the first time it is possible to place in your library at a very low cost a complete science Cyclopedia which is comprehensible to everyone. In these ten handy volumes is the whole story of the universe. They trace the world along the long road of evolution, and man's origin from the earliest unicellular life to the complex and highly specialized creature who rules supreme today, who, with infinite toil, has wrested from nature the secrets told in these books.

This Cyclopedia is offered as a supplement to Technical World Magazine, because it is a record of the scientific facts that are now established, while Technical World records all new discoveries and achievements. So you see these books and a file of Technical World Magazine constitute a complete science history right down to the minute that the current number of Technical World is laid on your library table.

What Big Men Say

"The collection of this vast amount of information from the stupendous bulk of the world's scientific lore and the concentration into a set of ten books in such fascinatingly interesting shape is certainly an exceptionally masterful piece of editorial work. But what strikes one as a yet more puzzling wonder is that you give the complete set of these ten volumes as a premium for a merely nominal additional sum."

HUDSON MAXIM, The Inventor.

"I have received the ten volumes of the Science-History of the Universe and consider it an excellent work. It deals with subjects often treated in a technical way, in a manner that will interest all readers."

ALBERT J. BEVERIDGE,
U. S. Senate, Washington, D. C.

Our Liberal Offer. We will send you the ten volumes of the Science-History of the Universe, carefully packed, all charges prepaid and Technical World Magazine for one year, twelve numbers, for only $3.90. Send money in way most convenient. The books and magazines may go to any addresses you choose.

What These Great Books Contain:

VOL. I. ASTRONOMY—Telescopes, Spectroscopes, Gravitation, Solar System, Stars.
VOL. II. GEOLOGY—Structure, Eras, Mines, Minerals, Quarries.
VOL. III. PHYSICS—Matter, Heat, Sound, Light, Magnetism, Electricity.
VOL. IV. CHEMISTRY—Alchemy, Modern Chemistry, Agricultural, Physiology.
VOL. V. BIOLOGY—Origin, Nutrition, Descent, Reproduction, Heredity, Evolution.
VOL. VI. ZOOLOGY—Fossils, Insects, Vertebrates. BOTANY—Structure, Growth, Forestry.
VOL. VII. ANTHROPOLOGY—Racial Characteristics. MEDICINE—Anatomy, Diagnosis, Surgery.
VOL. VIII. MATHEMATICS—Arithmetic, Algebra, Geometry, Surveying.
VOL. IX. ART—Architecture, Music. LITERATURE—Drama, Poets, Prose, Novels.
VOL. X. PHILOSOPHY—Schools, Development, Political Economy, Ethics.

Science-History of the Universe, ten volumes prepaid, and Technical World Magazine for one full year, only $3.90

Send Today

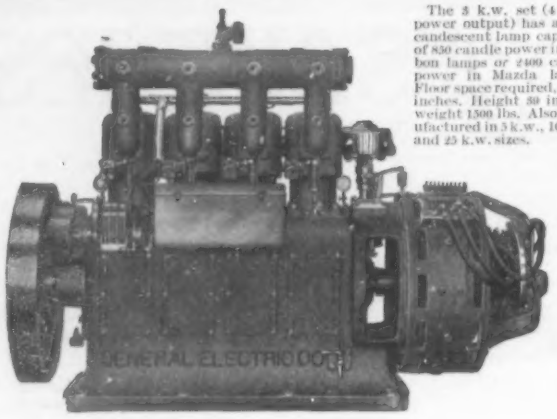
Use the Coupon

S.A. 3-11

Tech. World Magazine
5765 Drexel Ave.
Chicago, U. S. A.

Gentlemen:—Enclosed please find $3.90, for which send me the ten volumes of the Science-History of the Universe and Technical World Magazine for one year.

NAME .....
ADDRESS .....
CITY .....
STATE .....



The 3 k.w. set (4 horse power output) has an incandescent lamp capacity of 830 candle power in carbon lamps or 2400 candle power in Mazda lamps. Floor space required, 58x25 inches. Height 39 inches, weight 1300 lbs. Also manufactured in 5 k.w., 10 k.w. and 25 k.w. sizes.

Electric Light for Country Homes

An electric lighting plant equal in reliability to a large city system can be provided at a moderate cost for the country home isolated from central station service.

General Electric Gasolene-Electric Generating Sets

These sets should not be confounded with cheaply constructed outfits. G-E sets have four cylinders, insuring electric light without flicker. Direct mounting of the generator on the engine shaft does away with the noise, dirt and danger of belts. Very small floor space is required. The set can be easily installed in any convenient building. A bright boy can operate it. To those interested will be sent on request an illustrated Bulletin, which gives a full description. Address Dept. No. 59-A.

General Electric Company

Principal Office, Schenectady N. Y.

2903

POMPEIIAN BRONZE SCREEN CLOTH

LASTS AS LONG AS YOUR HOUSE

Don't specify any Screen Cloth till You investigate this

Ask your architect about Pompeiian or Golden Bronze Screen Cloth.

He will tell you it is the most economical barrier against flies and mosquitoes because it never has to be replaced. It lasts as long as your house.

He will tell you this screen cloth is 90 per cent pure copper. It cannot crack or rust even when left out doors all the year round. For copper is practically indestructible.

He will tell you, too, that you never have to bother to paint this enduring screen cloth. No meshes become choked through successive paintings.

It does not cast a shadow like dark painted wire cloth. All sunlight and air are admitted through its copper meshes. Even at a distance of 20 feet this screen cloth becomes invisible.

Your architect will tell you all these facts about Pompeiian and Golden Bronze Screen Cloth. Let him specify it for your new house.

And you home owners with rusty, cracked screen cloth, be prepared against the first inrush of flies. Tell your carpenter to refit the old screen frames with this new wire cloth. A removable "red string" along the selvage marks every foot of it, distinguishing this enduring screen cloth from copper-coated imitations.

If your dealer isn't supplied write us for the name of the nearest one who is. Your inquiry brings booklet on the comforts of screen cloth — outdoor dining and sleeping rooms, balconies, etc., etc.

Clinton Wire Cloth Co.

Established 1856 51 Sterling St., Clinton, Mass.

Your Success helps us.

That's why we advise you to get a home in the

San Joaquin Valley

We feel confident you will succeed there

Buy land there today. It will double in value. Develop it and this increase will double again.

The San Joaquin Valley contains 10,000,000 fertile, irrigable acres. There is abundant water to irrigate every acre. The people who are there are prospering; you also will prosper.

It is a country where good health prevails; where crops are bountiful; where local markets insure remunerative prices; where children are educated in America's best schools; where ten, twenty and forty acre farms bring independence. Where, by reasonable industry, a person with small capital can make good, have a home, a bank account, friends and insurance against future want.

Doesn't such a country interest you?

I am employed by the Santa Fe Railway to help people find homes along its lines. We can't afford to have you fail. Your success means more freight and passenger business, and that means prosperity for the Santa Fe.

The Company has no land for sale. I am here to investigate what others offer. If it is good, we tell people so. If it is bad, we warn people against it. We say without reserve that most of the land in the San Joaquin Valley is good.

I want to send to you our book, "The San Joaquin Valley," also a leaflet containing letters from forty farmers, and, if you ask it, our journal "The Earth" for six months. All Free.

C. L. Seagraves General Colonization Agent, A. T. & S. F. Ry. System, 906 Railway Exchange, Chicago.

FISK QUICK SAFE REMOVABLE RIM THE BEST

The Fisk Removable Rim is the Rim which during three years' service, with thousands in practical use, has demonstrated our right to solicit your 1911 equipment.

We do not ask you to "try out" an experiment---something with which it is impossible to prove conditions after six months or a year of wear.

The Fisk Rim is ***Always Quick---Always Safe---Always Satisfactory.*** It never sticks nor binds; has no short staybolts, no excessive weight, and requires no special tools.

It is THE RIM from which the tire cannot blow off and the one equipment which reduces inner tube expense.

Investigate and Compare.

The Fisk Rubber Co.

DEPARTMENT U

CHICOPEE FALLS, - - MASS.

23 Direct Factory Branches.

THE tire without a peer. The product of one of the most perfectly equipped and up-to-date tire factories of the present day. Manufactured under a system of supervision which has never been equaled.

"We Sell Continental Demountable Rims"

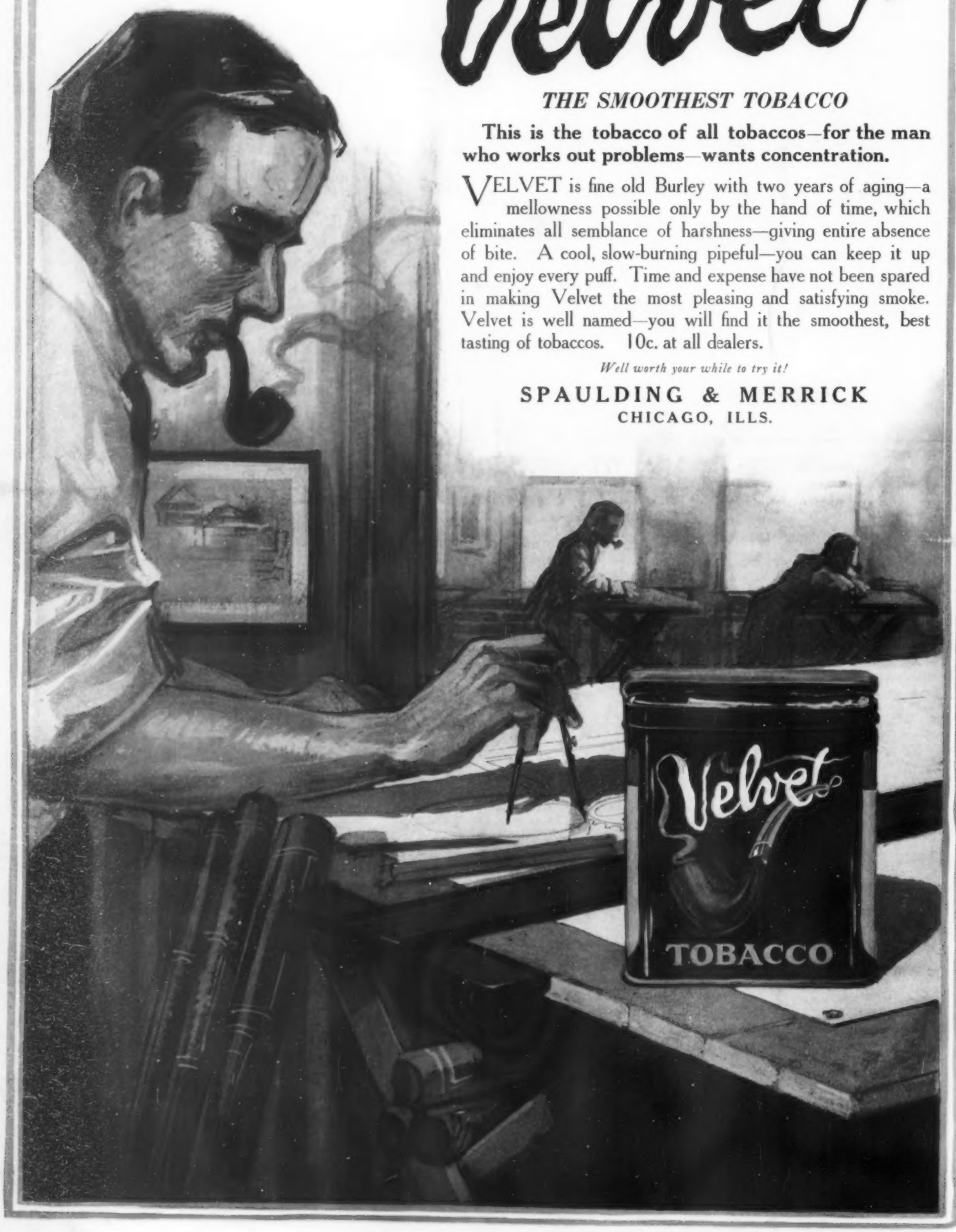
For Sound Thinking, Smoke

Velvet

THE SMOOTHEST TOBACCO

This is the tobacco of all tobaccos—for the man who works out problems—wants concentration.

VELVET is fine old Burley with two years of aging—a mellowness possible only by the hand of time, which eliminates all semblance of harshness—giving entire absence of bite. A cool, slow-burning pipeful—you can keep it up and enjoy every puff. Time and expense have not been spared in making Velvet the most pleasing and satisfying smoke. Velvet is well named—you will find it the smoothest, best tasting of tobaccos. 10c. at all dealers.

Well worth your while to try it!

SPAULDING & MERRICK
CHICAGO, ILLS.